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INTEGRATED LOGISTIC SUPPORT. IMPLEMENTATION GUIDE FOR DOD SYSTE--ETC(U)

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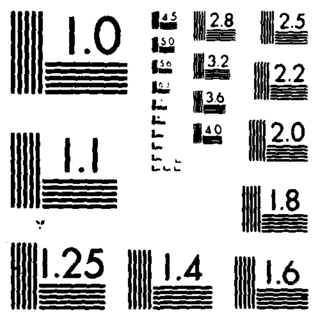

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INTEGRATED LOGISTIC SUPPORT

IMPLEMENTATION GUIDE FOR DOD SYSTEMS AND EQUIPMENTS

INTEGRATED LOGISTIC SUPPORT.

Implementation Guide for DOD Systems and Equipments.

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TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

It is the policy of the Department of Defense to include adequate and timely logistic support planning in all phases of the acquisition of Defense systems/equipments. This Integrated Logistic Support Implementation Guide for DOD Systems and Equipments is designed to assist program managers in government and industry in the implementation of that policy contained in DOD Directive 4100.35.

The principal test of effectiveness of a defense system or item of equipment is its capability and availability to perform a specified military requirement. Availability of a system or equipment is directly related to the reliability and maintainability and the effectiveness of its support system in the operational environment. A highly important consideration is the cost of ownership of the item through its entire life from conception through final disposition out of the inventory. The optimum balance between performance and life cycle cost of ownership can only be achieved by including logistic support considerations in all stages from the formulation and validation of the concept, through engineering design and development, test and evaluation, production, deployment and operations.

In discussion of the application of the ILS concept to various types of acquisition, description of ILS techniques and the relationship of ILS to other disciplines, this guide

facilitates improved communications between government and industry program managers, design, procurement, and financial managers, and between various agencies within the government.

The guide is organized to make it useful for program managers involved in the detailed planning and management of logistic support, and at the same time to be a valuable reference source for the non-specialist who needs assistance on specific problems with respect to logistic support and its interfaces.

Of interest to both the specialist and non-specialist, whether in Government or Industry, is the Standard Integrated Support Management System developed and approved by the Joint Logistics/Materiel Commanders. The Integrated Logistic Support techniques and processes contained in the SISMS document, as included in Service regulations, directions and specifications will contain specific guidance and requirements as applied to major system/equipment programs.

CHAPTER II

THE INTEGRATED LOGISTIC SUPPORT CONCEPT

A. Concept

The ILS concept is concerned with the definition, optimization, and integration achieved by systematic planning, implementation, and management of logistic support resources throughout the system life cycle. The concept is realized through the proper integration of logistic support elements with each other and through the application of logistics considerations to the decisions made on the design of the hardware system and equipment as a part of the system engineering process.

B. Objective

1. It has long been obvious to those responsible for the operation of military systems and equipments that support problems are a limiting factor on the operational capability availability of those systems. Much effort is expended in trying to increase mean time between failures or decrease periodic maintenance, and to reduce maintenance downtime. Operational commanders watch carefully the statistics on those items of equipment which are not operationally ready because of maintenance or supply difficulties. They recognize the importance of having personnel who are adequately trained to operate the equipment properly and to maintain it efficiently in order to reduce the number and frequency of failures and to reduce the adverse effect of such failures and maintenance time on operational readiness. They know the importance to their operation of adequate facilities and support equipment.

2. The Integrated Logistic Support concept must be applied throughout the acquisition cycle to ensure that systems are designed to meet operational requirements. All too often systematic consideration of the solution to the problems of support does not begin until the system is in the production/deployment phase. While some elements of support may receive early attention, it is rare that total support planning has a major impact on system design. This lack of timely and systematic planning adversely affects operational availability and cost of ownership.

3. Under the ILS concept, the importance of trading off operational and support requirements from the earliest phases of the life of a system has been recognized. As DOD Directive 4100.35 states: "Over the life cycle of a system, support represents a major portion of the total cost, and is sometimes the principal cost item." By integration of logistics considerations into the conceptual planning and through the entire design and development process, either support costs during the operation may be significantly reduced, or operational availability of the system may be increased without a significant increase in cost.

4. In addition to integrating support planning into the entire design and development process, it is also fundamental to the ILS concept that the elements of logistic support (as

listed and defined in Appendix B) shall be integrated with each other into a total support system. When the baseline of any one logistics element is changed or proposed to be changed, the effect on all other logistics elements and on the total system must be formally considered and necessary adjustments made.

5. In applying the concept of ILS to a system/equipment acquisition, it is important to maintain a proper perspective, to bear in mind that logistics support is not an end in itself, but exists only to support the operation of the system/equipment to which it is related. The support problem will vary according to the complexity and value of the system/equipment. Planning for support must be tailored to each acquisition individually; this guide addresses the differences of approach for major acquisitions, less-than-major acquisitions, off-the-shelf items, and modification programs.

6. It is also necessary to bear in mind that in any acquisition which includes development, there are two entirely different types of effort: first is the conceptual and broad planning stage; second is the period from full-scale development through final disposition, in which the actions contemplated in the first stage are refined and implemented. Just as support planning must be tailored to the type of acquisition, it must also be tailored to the time phasing of the acquisition process.

7. The first part of the logistics problem in an acquisition is to establish basic characteristics which will enable the operational requirements to be achieved. Program managers must keep the operational mission clearly in view during the early stages, and they should recycle and refine their planning to determine what is the minimum which must be accomplished prior to full-scale development. Once the basic logistics system characteristics are formulated, they must be stated to the design engineers in a "design-to" or "design constraint" fashion. When requirements are stated in this format, they may be used in analytical and trade-off studies. In the development of the logistic support concepts and the early planning for support, program managers must assure that logistic and design personnel work together in an atmosphere of maximum cooperation and communication. Thus, the ILS function must be closely identified as an integral part of the total system engineering process.

8. The logistics effort in the early stages must be confined to development and formulation of inclusive but broad logistics plans and support characteristics. The result should be a road map of what specific steps will be taken, at what time, and in what detail as the development progresses and the design matures. The detailed planning and preparation of detailed data packages must be deferred until the configuration of the hardware has been reasonably stabilized. Detailed support planning which is accomplished prior to the establishment of the basic configuration and dependent on that configuration is almost certain to require extensive rework to become valid and useable.

9. The techniques for the application, testing and demonstration of ILS planning and the requirements for the management of the logistics effort at various stages of the acquisition process are covered in greater detail later in this guide.

CHAPTER III

APPLYING THE CONCEPT

A. Principles of Application

Effective application of the Integrated Logistic Support concept requires recognition of four basic principles:

1. The definition, development and implementation of logistic support must include the consideration of those factors which significantly influence the effectiveness and the cost of support over the life cycle of the equipment system. The scope and depth of the consideration must be in keeping with the phase of the program. During early phases, emphasis is on the identification of design related support requirements consistent with overall requirements imposed on the system. During later phases, emphasis is on the establishment of a logistic support capability which is responsive to the technical characteristics of the equipment and to the operational requirement.

2. The elements which are required to establish the capability to support the system or equipment collectively constitute a "support system." The development of a logistic support system segment is achieved through systematic planning, analysis and taking positive actions to acquire the required support resources. The process includes techniques such as analyses and simulation (see Chapter VII) as appropriate and to the depths necessary to evaluate the logistic impact of alternate design approaches.

3. The elements of support must be defined, developed, and implemented as an integrated support system. Coherence, which must exist among the elements of support must be mutually compatible and provide the support capability required in operational use. Systematic definition, development and implementation will enable tradeoffs among the support elements themselves as well as trade-offs with system or equipment hardware through the system engineering process.

4. The support system must be responsive to requirements imposed by the equipment, its utilization, and its operational environment. This principle requires the orderly definition of logistic support elements prior to their acquisition. The establishment of specific quantitative performance design requirements and demonstration tests for the support system is an important prerequisite to insuring that support planning has resulted in developing the support capability required by operating forces.

B. Integration of Tasks

The ILS concept is implemented by the integration of ILS as a part of the system engineering process and through the implementation of four functional groups of tasks in acquisition programs: Support Engineering Tasks; ILS Planning Tasks; ILS Implementation Tasks; and ILS Management Tasks.

Support Engineering. This function, which interfaces the support system with the equipment system, is accomplished by performing analyses and engineering tasks which define support criteria (automatic fault detection, rapid processing capability,

etc.) as an input to the equipment design process and the support system optimization process. This process entails defining detailed support concepts and an engineering definition of corresponding support system requirements utilizing analytical models and support engineering analyses. Appendix A illustrates a sample logistic support system segment specification for documenting quantitative and qualitative support criteria as a technical baseline for ILS planning.

The primary aims of modeling are to aid in the establishment of initial logistic support concepts and to define logistic criteria which impact on trade-studies during the formulation of system technical requirements. As the system design progresses, quantitative analytical techniques (e.g., level of repair analysis, repair versus discard, and similar optimization studies) identify further specific support alternatives in the development of the support system. Chapter VII of this Guide contains a discussion of quantitative analytical techniques in addition to those available within individual contractor or government organizations.

Logistic Support Analyses are a composite of the technologies used in the definition of support requirements and the injection of support criteria into the acquisition process. Logistic Support Analysis (LSA) is recognized as one of the most useful of these technologies. The Analysis must have input/output relationships with operational requirements, maintainability and reliability programs, and other design related disciplines. It is used as a basis to develop a maintenance plan for the item under analysis and to define support resource requirements

for implementation of that plan. Logistic Support Analysis is most effective when it is conducted at progressively increasing levels of detail corresponding to the stage of application, effectiveness is further improved if the data quality is under surveillance of a logistics test, evaluation, or demonstration program. Figure III-1 summarizes four typical levels of detail in logistic support analysis. Note that formal LSA documentation is appropriate only at levels 3 and 4.

ILS Planning. Conceptual planning for ILS is accomplished initially by the government for each acquisition and the plan is progressively expanded and updated by joint Government/ Contractor efforts in phase with major program events. The function of the Integrated Logistic Support Plan (ILSP) is to identify the actions to be accomplished, assign responsibilities, and establish milestones. It accounts for the interaction of events and activities, provides for government/contractor management and review policies, establishes logistic support management information reporting requirements, and provides for the definition, integration, and subsequent acquisition of the support elements. Initial planning must be sufficient to establish the scope of ILS activities for the initial phase of the acquisition process, and is generally limited to the consideration of special problems. During each phase the level of detail in ILS planning must be sufficient to provide support for equipment which is deployed or utilized during that phase. It must establish scope and depth of activities

to be accomplished in the succeeding phase and should make provisions for an orderly transition to the succeeding phase. Careful attention must be given to lead time requirements and to ILS activities which are prerequisites to events occurring in other support elements (e.g., establish maintenance concept before designating support and test equipment).

ILS Implementation. ILS planning reaches operational maturity during the production/deployment phase and implementation is accomplished by the procurement and activation of support elements in accordance with the scheduled requirements. It is essential that the activation and implementation schedule permit systematic definition and contractual coverage of the scope and depth of support elements and services prior to commitment to their acquisition. FIGURE III-2 indicates the critical points in the support engineering process as a guide in the acquisition of support elements.

Management Consideration. To organize effectively for the application of ILS it must be recognized that the integration of the logistic considerations into the hardware system being acquired requires analytical and developmental logistic activity phased with the prime equipment analytical and development activity. This requirement directs that program managers organize their staffs at the appropriate time to include this function in the manner best suited for the particular acquisition. ILS management is discussed in detail in Chapter X.

C. Depth of Application

Although the application of ILS must be given managerial and technical attention beginning with conceptual studies, the program manager must be judicious as to the degree of application as a function of the specific acquisition process. The phases may vary with each acquisition and the depth of application must be tailored to the specific program. The following summary, which presents support system actions during a typical sequence in an acquisition process, may be used to guide the program manager.

1. Program Initiation

a. Conceptual Effort. Characterized by the generation of system planning and utilization data in sufficient detail to allow gross life cycle cost analyses and the definition of baseline operational and support concepts. The operation and maintenance environment is described covering extremes and worst case conditions. At this time, support system and equipment system interfaces are initially defined. First order quantified support goals and equipment functional characteristics required to meet these goals should be established and described in the preliminary system specification.

b. Advanced Development. Characterized by the specification of criteria by which logistic and support considerations impact on the design and configuration of the equipment system. Trade studies are conducted to achieve an optimum balance between performance and life cycle costs. The logistic support system

segment specification (see Appendix A) is updated to include further defined quantitative and qualitative support system requirements. A preliminary ILSP will be prepared providing for the orderly development of solutions to unique support problems in accordance with the requirements documented in the system specification.

2. Full Scale Development. Characterized by an iterative interface with system engineering and detailed design for the incorporation of the support features desired to reduce maintenance time and servicing requirements. Tests, simulations, and demonstrations will be conducted in which the features of system design and the capability of the support system are evaluated (see Chapter IX). The preliminary ILSP is expanded to reflect the activities for test support, pre-operational support, implementation of each support element, and to establish performance and reporting requirements for monitoring ILS progress.

3. Production. Characterized by the activation of operational sites and the delivery and implementation of the support system. Highlights of this phase will include a continuing evaluation of the equipment and its support system by the user, evaluation of data from the data collection system, initiation of a feedback system, and implementation of a corrective action system.

4. Deployment and Operation. Characterized by the operation of the logistic support system in the deployed environment and

the continuous evaluation of its performance. Performance is measured both in terms of the effectiveness with which the equipment system performs and in terms of the efficiency of the support system. Potential improvements in the support system are identified, evaluated, and implemented if appropriate.

Figure III-1 Progressive levels of the Logistic Support Analysis Process

Designation	Application Period	Depth of Analysis/Application of Output Data
Level 1	Prior to full scale	To a level sufficient to provide cost relatable inputs to logistic simulations, cost effectiveness models, and trade-off studies, and life cycle cost analysis.
Level 2	Full scale development (system design)	To a depth sufficient to provide inputs to equipment design which optimize support characteristics; input to economic repair/discard analyses, establish baseline maintenance concept for preliminary ILS planning.
Level 3	Full scale development (detail design)	To a depth sufficient to identify logistic requirements, establish detailed maintenance plan, inputs to ILS plan, verify support parameters, and provide logistic support documentation.
Level 4	Production/Deployment	Same depth of analysis in Level 3 applicable to engineering changes, logistics studies, and major modifications.

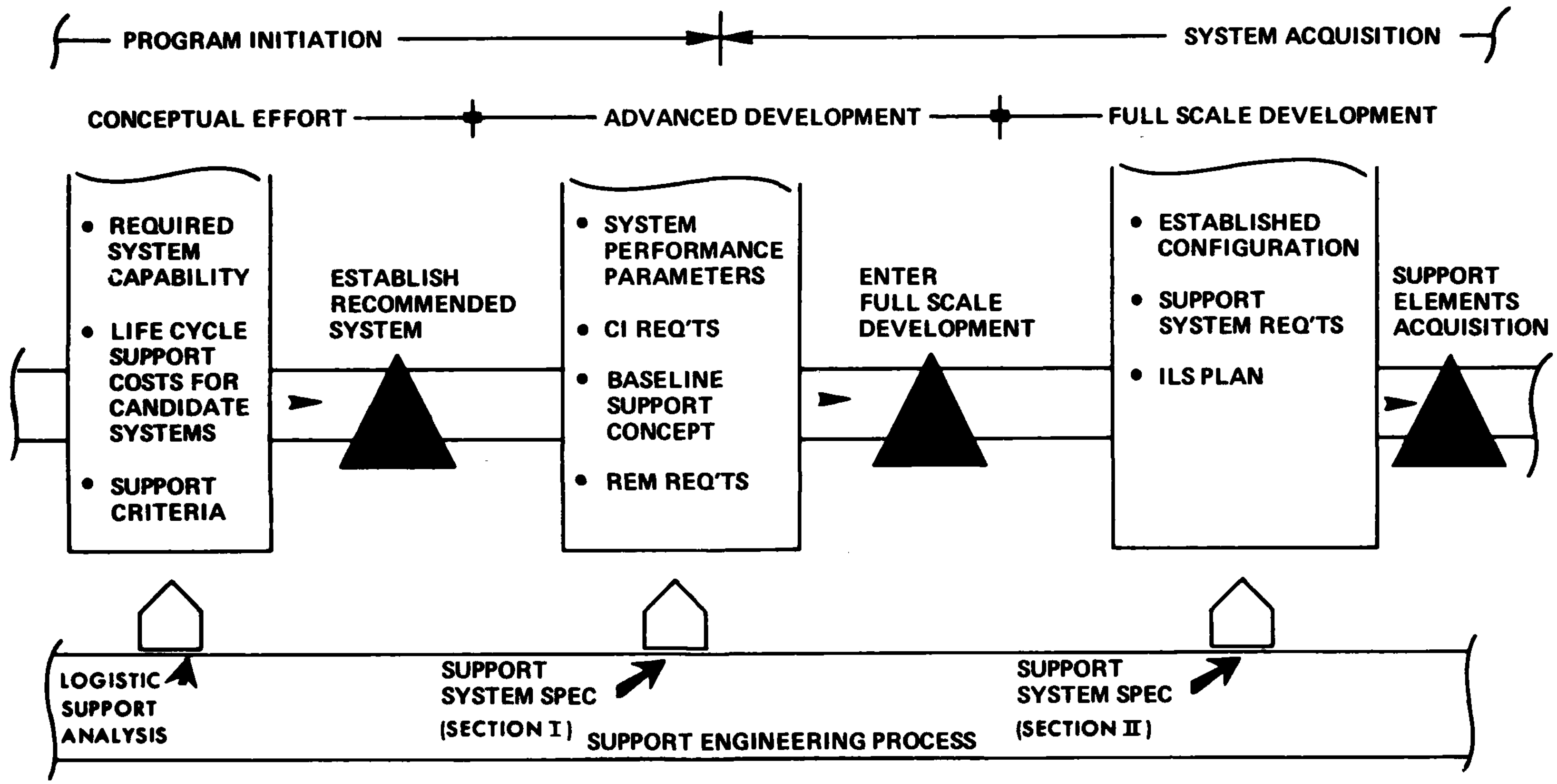


FIGURE III-2 CRITICAL MILESTONES IN DEVELOPMENT OF THE SUPPORT SYSTEM

CHAPTER IV

APPLICATION OF ILS TO A MAJOR ACQUISITION

A. Introduction

1. The objectives of ILS planning include the reduction of support requirements and remaining support costs to a level consistent with operational readiness requirements. This objective will not be met by routine observation of support needs. Its attainment requires systematic evaluation of the design and support characteristics as a part of the systems engineering process by technically qualified specialists. This involves the iterative assessment of the impact the design will have on specific technical and support requirements. The effectiveness of such an assessment and its influence on design is dependent on the meaningful application of the ILS concept during all phases of acquisition.

2. Support planning requires a close and dynamic working relationship between systems engineering, detailed design and logistic support personnel. It involves repeated review and refinement of emerging support characteristics and their probable impact on design requirements, including operational readiness performance characteristics. Qualified support performance descriptors in the form of maintainability and reliability characteristics and projected support requirements thus become a yardstick against which design of the support system can be defined and support planning can be accomplished in terms of assigned tasks and needs. Key characteristics of the support system must be expressed in

terms of "numbers" measuring system availability, utilization, downtime, turnaround, crew requirements, maintenance man-hours per operating hour, defined constraints, etc., as appropriate to the equipment type and intended use. The performance of the support system can then be evaluated in terms of finite measurements.

B. <u>Overview of ILS Activities</u>

Both government and industry program managers must assure that their specialists responsible for the various support elements: (1) understand the system or equipment mission objectives, (2) define actions and resources required for complete life cycle support, (3) schedule actions and commit resources to support system development and future operations, (4) request and utilize funds in a preplanned sequence to prevent cost overruns and unnecessary program delays, and (5) use performance and management data and standard control techniques to maintain an information and experience exchange. See figure IV-1.

1. <u>Conceptual Effort</u>. ILS activities begin concurrently with the definition of major functions needed to provide an operational capability, e.g., new mission, weapon system, or equipment. Included in this activity is the definition of special logistic problems and an estimate of the current support capability which may apply in their solution. Current support capability is defined as existing procedures, repair facilities, skills, and equipment which could be used to

accommodate a new requirement. Trade-off studies are performed to evaluate alternative means for satisfying those requirements which cannot be satisfied effectively by existing support capabilities. The best of these support concepts are selected, along with appropriate requirements to be levied on the contractors, and are included in a logistic support section in the plan for system development.

2. Advanced Development

a. ILS activities are based on the requirements in the logistic support section of the plan for system development. The technical requirements are combined with management planning criteria providing guidance on the planning and support responsibilities of the government and the contractor in the Request for Proposal (RFP). Proposal evaluation criteria is also documented for subsequent use by source selection personnel. Contractor proposals should be evaluated for: (1) the degree to which they meet or exceed support specifications; (2) comparative credibility of life cycle cost estimates; and (3) demonstrability of specifications goals and requirements. Successive iterations of these proposal activities are often necessary to select the best equipment and support approach. These actions result in development of definitive equipment and support specifications.

b. The selected contractors response to the Statement of Work (SOW) plus detailed technical and management criteria for development phase planning are combined in a support system segment

of the system specification (Appendix A) for inclusion in the development phase contract. Contract data requirements will be tailored to meet the specific needs of the program. Anticipated requirements established by the government for maintenance actions, equipment, personnel, training, spares, and data are identified. Development contracts must define equipment readiness (in terms of maintainability and reliability related performance requirements) as well as other support descriptors and requirements, schedules and controls, and system and subsystem demonstrations to be conducted for the verification of conformance to specification requirements.

3. Full Scale Development. ILS activities begin with the further definition of detailed logistics support concepts and resource requirements as the system/equipment design progresses. Maintenance actions, times, levels, locations, and the requirements for spares and repair parts, facilities, personnel, training, training equipment, technical data, tools and test equipment are refined for established configurations. Limited quantities of resources (test equipment, spares, technical manuals) are procured for tests which include the evaluation of the logistic support system against its specification. Acceptance of the support system to specification requirements will assist in establishing a firm product baseline for follow-on procurement. Service tests should be conducted in a preplanned operational environment to verify mission equipment--support system compatibility and the sufficiency of support planning and implementations.

Deficiencies found during test are corrected by engineering change or by changes in the support plan.

4. Production. Logistic support resources, e.g., spares, repair parts, manuals, test equipment, handling equipment, training equipment are acquired in conjunction with the contract end item. Design changes are evaluated for their impact on support planning prior to their submission to the customer for approval and support resources acquired in conjunction with end item change acquisition procedures. The availability for support resources necessary for equipping the first and subsequent operational organization is verified.

5. Deployment and Operations. ILS activities begin with delivery of initial production units to the first operating organization for operational testing. During this test, operational and support plans and resources are evaluated for achievement of their prescribed goals. All deficiencies are identified and evaluated by design/support trade-offs prior to making modification decisions. Modifications incorporated either in new production runs or as minor changes at the operating unit are documented together with the reason for the change.

C. Model Statements of Work

1. The application of ILS to a major system requires that statements of work be prepared for each phase of the acquisition and that key milestones and prerequisites should be in the form of specific inputs and output objectives and should satisfy transitional requirements such as the Defense Systems Acquisition Review Council (DSARC) check list.

Figures IV-2 through IV-6 illustrate minimum prerequisites for an orderly progression of ILS activities in a typical sequence of contract events. These figures provide a guide for the development of statements of work to be included in the RFP. These statements of work for each phase can be tailored for each particular acquisition and should be used to identify minimum essential data requirements. In writing a statement of work for a given phase, the RFP writer must take into account the work already accomplished in earlier phases and the work which is to be accomplished by the government during the given phase. Using the model statement of work as a guide, he can thus determine the specific work statements to include in the RFP. The aggregate of work accomplished from all sources at the completion of the given phase must reflect an acceptable posture required for entry into the next phase.

2. The model statements of work represent the aggregate of work to be accomplished by both the government and industry prior to entry into each succeeding phase. The aggregate for each phase thus becomes a checklist or point of departure from which the RFP writer may deduct those tasks already accomplished and those to be performed in-house and arrive at the appropriate requirements for the RFP. Most model statements of work are not sufficiently detailed for use verbatim in an RFP, and require tailoring to the specific acquisition and to the overall needs of the ILS program.

MAJOR PROGRAM PHASES	PROGRAM INITIATION		FULL SCA DEVELOP
	CONCEPTUAL EFFORT	ADVANCED DEVELOPMENT	
DESCRIPTION OF MAJOR PROGRAM ACTIVITY	TECHNICAL, MILITARY, & ECONOMIC BASES FOR AN ACQUISITION PROGRAM ARE ESTABLISHED THROUGH SYSTEM FEASIBILITY STUDIES. MAJOR OUTPUT CONSTITUTES A DECISION ON WHETHER OR NOT A SYSTEM PROGRAM SHOULD BE PURSUED.	PREPARATION OF DEVELOPMENT CONCEPT PAPER (DCP). DCP INCLUDES DEFINITION OF SYSTEM NEED AND DEFINES PROGRAM ISSUES, INCLUDING PROGRAM OBJECTIVES, SPECIAL LOGISTICS PROBLEMS, PERFORMANCE PARAMETERS, AREAS OF MAJOR RISK, SYSTEM ALTERNATIVES AND ACQUISITION STRATEGY.	THE SYSTEM (INCLUDING NECESSARY FOR ITS SUP IS DESIGNED AND DEVEL RELIABILITY, MAINTAIN LOGISTICS ARE MAJOR C IN THE DESIGN PROCESS. MODELS AND PROTOTYP ARE FABRICATED AND T TEST AND EVALUATION • DEVELOPMENT TEST & EVALUATION-DEVELO ENGINEERING TESTS. • OPERATIONAL TEST & SUITABILITY TESTS. TESTS ARE CONDUCTED T DETERMINE: EXPECTED EFFECTIVENESS; OPERAT ORGANIZATION, DOCTRI FOR SYSTEM DEPLOYME
PRIMARY DECISION POINTS	DSARC	DSARC	
MAJOR INTEGRATED LOGISTICS SUPPORT ACTIVITY — — — — REFER TO FIGURE IV-2 THROUGH FIGURE IV-6 FOR DESCRIPTIVE MATERIAL.	A.1 <u>OPERATIONAL CAPABILITY PLAN</u> • GEOGRAPHICAL DEPLOYMENT CONCEPT • UTILIZATION CONCEPT • OPERATIONAL ENVIRONMENT • MAINTENANCE ENVIRONMENT A.2 <u>FUNCTIONAL SUPPORT REQUIREMENTS</u> • DEFINITION OF INTERFACE WITH: OTHER EQUIPMENT SYSTEMS; OTHER SUPPORT SYSTEMS; GOVERNMENT RESOURCES. • DEFINITION OF QUANTITATIVE GOALS (MTBM, MDT, MMH/OH, $/OH)	B.1 <u>CONTRACT EQUIPMENT SYSTEM SPECIFICATION</u> • REQUIREMENTS FOR BIT/BITE. • RELIABILITY DESIGN CRITERIA • MAINTAINABILITY/MAINT. DESIGN CRITERIA B.2 <u>CONTRACT SUPPORT SYSTEM SPECIFICATION</u> • QUALITATIVE & QUANTITATIVE SUPPORT SYSTEM REQUIREMENTS (CRITERIA) • DEFINITION OF SUPPORT ELEMENT BASELINES. • BASELINE MAINTENANCE CONCEPT. B.3 <u>PRELIMINARY ILS PLAN</u> • TASK ORIENTED PLAN FOR DEVELOPMENT, TEST & EVALUATION OF CONTRACTOR SUPPORT ELEMENTS. • BASELINE SCHEDULE FOR INTEGRATION OF CONTRACTOR SUPPORT ELEMENTS.	C.1 <u>SUPPORT SYSTEM EVALUATION REP</u> • ACHIEVE QUAL QUANTITATIVE SYSTEM REQUI • ACHIEVE EQUI SYSTEM RELIA MAINTAINABIL CHARACTERIST C.2 <u>ILS PLAN</u> • DEVELOP DETA MAINTENANCE • DEVELOP PLAN ALLOCATION & OF CONTRACT ELEMENTS. • DEVELOP PLAN INTEGRATION SUPPORT ELEM GOVERNMENT WITH PRIME/A ELEMENTS.

FIGURE IV-1--INTEGRATED LOGISTICS SUPPORT (I

...CALE ...OPMENT	PRODUCTION	DEPLOYMENT/ OPERATIONS
...ING ITEMS ...SUPPORT) ...VELOPED. ...AINABILITY & ...R CONSIDERATIONS ...ESS. ENGINEERING ...TYPE SYSTEMS ...D TESTED. ...ION INCLUDES: ...ST & ...VELOPMENT & ...STS. ...ST & EVALUATION-- ...TS. ...TED TO ...TED OPERATIONAL ...ERATIONAL SUITABILITY; ...CTRINE, TACTICS ...YMENT.	THE SYSTEM INCLUDING ITEMS NECESSARY FOR ITS SUPPORT (SUPPORT EQUIPMENT, TRAINING EQUIPMENT, SPARE/ REPAIR PARTS, SOFTWARE, DATA, ETC.) IS PRODUCED FOR OPERATIONAL USE.	THE PRODUCTION SYSTEMS ARE DEPLOYED FOR OPERATIONAL USE AND SUSTAINED BY FIELD OPERATIONAL UNITS.
DSARC		
...STEM TEST & ...N REPORT ... QUALITATIVE & ...TATIVE SUPPORT ... REQUIREMENTS ... EQUIPMENT ... RELIABILITY & ...NABILITY/MAINT. ...TERISTICS. ...P DETAILED ...NANCE PLAN ...P PLAN FOR PRODUCTION ...TION & IMPLEMENTATION ...TRACTOR SUPPORT ...TS. ...P PLAN FOR ...ATION OF CONTRACTOR ...T ELEMENTS WITH ...NMENT RESOURCES & ...RIME/ASSOC. ...TS.	D.1 USER OPERATIONAL EVALUATION • USER OPERATIONAL & SUPPORT PLAN. • PRODUCTION AND DELIVERY OF EQUIPMENT SYSTEM AND SUPPORT SYSTEM ELEMENTS. • ILS PLAN IMPLEMENTATION D.2 CORRECTIVE ACTION SYSTEM • SUPPORT MANAGEMENT (CONTRACTOR TO CUSTOMER TRANSITION TASKS). • DATA COLLECTION, ANALYSIS, AND FEEDBACK SYSTEM • SUPPORT SYSTEM ENGINEERING PLAN (ENGRG. SUPPORT OF MODIFICATIONS & UPGRADING OF SUPPORT SYSTEM. • SUPPORT SYSTEM CHANGE CONTROL.	E.1 OPERATIONAL & MAINTENANCE SUPPORT • EQUIPMENT SYSTEM & SUPPORT SYSTEM OPERATION AND MAINTENANCE SUPPORT. • PERSONNEL OPERATION & MAINTENANCE TRAINING. • MATERIAL (SPARE/REPAIR PARTS, CONSUMABLES, ETC.) E.2 SYSTEM EVALUATION • DATA COLLECTION, ANALYSIS & FEEDBACK SYSTEM.

Figure IV-2

DEVELOPMENT OF A MODEL STATEMENT OF WORK FOR INTEGRATED LOGISTIC SUPPORT
- CONCEPTUAL EFFORT -

STEP 1[1]

A. REQUIREMENTS FOR ENTRY INTO ADVANCED DEVELOPMENT

..A baseline concept has been established for the deployment and utilization of the equipment system[5] and preliminary functional requirements have been allocated to the support system..[6]

STEP 2[2]		STEP 3[3]
Products of Evaluation	**Task Oriented Prerequisites**	**Model Statement of Work for Conceptual Effort**
A.1 Operational Capability Plan	A.1.a Definition of geographical deployment concept	System planning and utilization data shall be established for the preferred system.[7]
	A.1.b Definition of utilization concept	This information may be generalized in nature but must be of sufficient detail to be utilized in life cycle cost analyses; in subsequent establishment of the maintenance concept for the system; and must be of sufficient detail to allow its consideration in defining the maintenance environment during this phase.

Figure IV-2 (Cont'd)

STEP 2[2]		STEP 3[3]
	A.1.c Definition of operational environment A.1.d Definition of maintenance environment	The operation and maintenance environment shall be defined for the system. This data will include the types of bases, i.e., fixed, mobile, hard, austere, ship, etc., and a description of the maintenance environment which is expected at Organizational, Intermediate, and Depot levels including climatic conditions. Facilities to be used shall be defined in terms of mobile facilities, fixed facilities, new vs. existing areas, CONUS vs. overseas.
A.2 Function Support Requirements	A.2.a Definition of interface with other equipment systems	The interface between the preferred system and other equipment systems which influence the support system shall be defined. This requirement includes the interface with parent systems in which the preferred system will operate and associate systems with which it operates. The interface must be defined to the extent that unique support system requirements can be considered during validation and can be subsequently reflected in logistic support system segment specifications.

Figure IV-2 (Cont'd)

STEP 2[2]	STEP 3[3]
A.2.b Definition of interface with government resources	Government resources applicable in support of the preferred system shall be identified. Major items of consideration include operation and maintenance personnel, facility requirements (new, existing, modified, available) common and standard items of support equipment, and any other applicable logistics resources which may impact on support system definition.
A.2.c Definition of interface with other support systems	The interface with other support systems shall be defined and the level of any common usage shall be specified.[8] This requirement includes: major items of support equipment such as at a depot); the level of commonality required; the use of previously specially trained personnel and handling and transportation systems; and the utilization of required commonality with any major software systems expected to be in being at the same time.

Figure IV-2 (Cont'd)

STEP 2[2]	STEP 3[3]
A.2.d Definition of quantitative support goals	Analyses shall be performed to determine the quantitative support goals and equipment characteristics which are required to meet overall operational objectives of the preferred system.[8] Examples of support requirements include as applicable turnaround time, availability, downtime, maintenance manhours per operating hour, mean-time-to-repair, or mean-time-between-maintenance-action/

Figure IV-3

DEVELOPMENT OF A MODEL STATEMENT OF WORK
FOR INTEGRATED LOGISTICS SUPPORT
- ADVANCED DEVELOPMENT -

STEP 1[1]

B. REQUIREMENTS FOR ENTRY INTO FULL SCALE DEVELOPMENT

..Requirements and specifications have been imposed on the equipment system[5] such that, when met, will allow support to be accomplished within predetermined requirements..

Products for Evaluation	Task Oriented Prerequisites	Model Statement of Work for Advanced Development
B.1 Contract Equipment System Specification	B.1.a Definition of requirements for Built-in Test/Built in Test Equipment (BIT/BITE) or automatic testing.	The government shall specify the criteria by which logistics and support considerations shall impact on the design characteristics and the configuration of the equipment system.[9]
	B.1.b Definites of required system maintenance characteristics.	The contractor shall as a result of overall system analysis optimize the overall configuration of the system[10] in accordance with the criteria established by the government. Electrical, mechanical, and physical characteristics of the equipment system which are essential for compatibility with the specified support system shall be included in the equipment system specification. As a minimum, BIT/BITE requirements and system reliability requirements shall be specified.
	B.1.c Definition of required system reliability	

Figure IV-3 (Cont'd)

B.2 Contract logistic support system segment specification[12]	B.2.a Definition of quantitative contract support system requirements B.2.b Definition of qualitative contract support system requirements B.2.c Definition of baseline maintenance concept B.2.d Definition of support element baselines	The contractor shall develop a logistic support system segment specification[11] responsive to the Operational Capability Plan and the Functional Support Requirements. The logistic support system segment specification shall include quantitative and qualitative support system requirements,[12] a baseline maintenance concept; and baseline requirements for each element of the support system. The support system thus specified shall represent the optimized equipment/support system interface established by overall system analysis and trade-off using predetermined optimization criteria.
B.3 Preliminary Integrated Logistic Support Plan[13]	B.3.a Definition of task-oriented plan for production and evaluation of contractor support elements B.3.b Definition of baseline schedule for integration of contractor support elements with government furnished elements and prime or associate elements	The contractor shall develop a preliminary Integrated Logistic Support Plan[13] which (a) identifies those tasks which must be accomplished in order to develop and evaluate the contractor support elements[14] represented by the Support System Specification and (b) establishes milestones for integration of government furnished elements and associate contractor elements which will be required in the evaluation/demonstration of the support system. The preliminary ILSP shall be sufficient to establish the scope of work for full scale development and shall indicate required action by government agencies and associate contractors relative to ILS planning.

Figure IV-4

DEVELOPMENT OF A MODEL STATEMENT OF WORK
FOR INTEGRATED LOGISTICS SUPPORT
- FULL SCALE DEVELOPMENT PHASE -

STEP 1[1]

C. REQUIREMENTS FOR ENTRY INTO PRODUCTION
.. It has been verified that the logistic support system[6] will permit operation and support of the equipment system[5] within the resources planned for that purpose..

STEP 2[2] Products for Evaluation	Task-Oriented Prerequisites	STEP 3[3] Model Statement of Work for Full Scale Development
C.1 Support System Test and Evaluation Report	C.1.a Achieve quantitative and qualitative support system requirements C.1.b Achieve equipment system reliability requirements and maintenance characteristics	The contractor shall include as an element of his Development program, maintainability program tasks which will (a) cause the equipment system to contain maintenance characteristics which permit maintenance to be performed within the specified support system requirements; and (b) cause the support system to achieve the specified quantitative and qualitative requirements of the logistic support system segment specificiation. The Development program will include the development and verification of each support element[14] to the extent necessary to permit formal evaluation of the integrated support system during the Development phase.

Figure IV-4 (Cont'd)

		Demonstrations shall be conducted in which quantitative and qualitative requirements[12] are demonstrated and in which the performance of the support system is evaluated against the logistic support system segment specification.[11]
C.2 Integrated Logistics Support Plan	C.2.a Develop detailed maintenance plan C.2.b Develop plan for production, allocation, and implementation of contractor support elements	The contractor shall expand the preliminary ILSP to reflect the production, allocation and implementation of contractor support elements. The ILSP shall contain a detailed maintenance plan based on the approved operational and maintenance concept and will reflect utilization of products of the support system specification. The plan shall identify and define the range and depth of resources required to support the equipment system in sufficient detail to enable the user to plan and implement operational support.
	C.2.c Develop plan for integration of contractor support elements with government resources and with prime/associate elements	The expanded ILSP shall further reflect the integration of government resources with the contractor support elements and will define the interface with elements of associate and/or prime support systems.

Figure IV-5

DEVELOPMENT OF A MODEL STATEMENT OF WORK
FOR INTEGRATED LOGISTIC SUPPORT
- PRODUCTION PHASE -

STEP 1[1]

D. REQUIREMENTS FOR ENTRY INTO DEPLOYMENT PHASE
..Support elements[14] have been positioned and are in operation as a support system[6] which will perform to the requirements imposed on the support system..

STEP 2[2]		STEP 3[3]
Products for Evaluation	Task-Oriented Prerequisites	Model Statement of Work for Production
D.1 User Operational Evaluation	D.1.a User operational and support plan	The government shall establish the requirements and criteria for conducting the user evaluation of the operational and support systems. The requirements shall indicate the type and extent of evaluation to be conducted; the geographical location and user facilities and resources available; and the system operational plan. The contractor shall prepare an operational and support plan for the overall evaluation process. This plan shall be consistent with the detailed maintenance plan and with the ILSP.

Figure IV-5 (Cont'd)

	D.1.b Production and delivery of equipment system and support system elements	The contractor shall produce and deliver those elements of the equipment and support system which are essential to operation and support of the equipment system. The production and delivery shall be on a schedule which permits user evaluation to be accomplished in accordance with the plan described above.
	D.1.c ILSP implementation	The government shall take appropriate action to implement the ILSP. Contractor tasks shall be implemented as elements of the production program. Government and associate contractor tasks shall be implemented on compatible schedules in accordance with the ILSP.
D.2 Corrective Action System	D.2.a Support Management Plan	As a supplement to the ILSP, the Government shall establish a Corrective Action System which includes a support management plan, a logistic support system segment engineering plan, a data collection and feedback system and support system change control. The Government may require that the contractor provide for Government approval plans for any part or all of the Corrective Action System.[15] The support management plan shall reflect the organizational responsibilities, contractor-user interfaces, implementation procedures, scheduling information as appropriate, data reporting requirements, and monitoring and control provisions.

Figure IV-5 (Cont'd)

	D.2.b Data collection and feedback system	Basic requirements and specific criteria shall be defined for the design and implementation of a data collection and feedback system. The data system shall provide for: periodic assessment of the operational and support system, the analysis of raw data and the evaluation of the system in terms of compliance with support system requirements; and for recognition of deficiencies and recommendations for corrective action.
	D.2.c Logistic Support System Segment Plan	A logistic support system segment plan and a support system change control plan shall be established as elements of the overall support system plans. The support system plan shall provide for continuous evaluation, modification and upgrading of the support system. Planning shall include: corrective action stemming from the data collection and feedback system; evaluation of recommendations and where applicable incorporation of cost effective improvements; design and development test and installation of modification kits; engineering support as required to assist the user in the operation and maintenance of equipment.

Figure IV-5 (Cont'd)

	D.2.d Support system change control	The Support System Change Control program shall provide control and configuration accounting for all changes to the support system and maintain concurrency and compatibility of the support elements.

FIGURE IV-6

NOTES

[1]Step 1 in the development of ILS statements of work for a given phase is to determine the acceptable posture of the support system[6] prior to entry into the next phase. The required posture for entry into the next phase is shown as Step 1. It is intended that response to the statement of work permits achievement of this posture.

[2]Step 2 in the development of ILS statements of work for a given contract phase is to: (a) identify products of that phase which would serve as convenient vehicles for reflecting or evaluating the required posture[1], and (b) identify task-oriented prerequisites for each product. It is intended that the statements of work will be limited specifically to accomplishment of the prerequisites. It is also assumed that the products of the contract phase will include those products listed under Step 2.

[3]Step 3 in the development of ILS statements of work for a given contract phase is to develop statements of work which would satisfy the task-oriented prerequisites[2]. The model SOWs presented under Step 3 are not necessarily intended for inclusion verbatim in RFPs. They represent the sum of essential requirements for the given contract phase and should be used as a guide in developing detailed statements of work for RFPs. The composite of the detailed statement of work should be equivalent to the model SOW shown under Step 3. The statements of work may also be conceptually applied to the in-house conduct of program phases by the government or portions may be divided between government and contractor.

[4]The system requirement as used here refers to the anticipated requirement to which the advanced study is directed. The system requirement may be a gross consideration such as failure-free operation for a specified period of time in excess of the current state-of-the-art; or it may be a specialized requirement such as high density packaging of components to achieve weight/volume characteristics in excess of current state-of-the-art.

[5]The equipment system as used herein refers to those items which collectively constitute the hardware portion of the total system. Unless otherwise indicated, it refers only to the equipment system being acquired by the current RFP action.

[6]The logistic support system as used herein refers to those elements of support which are required collectively to maintain and logistically support the equipment system.[5] The support elements which constitute the support system are listed in DOD Directive 4100.35.

FIGURE IV-6 (Cont'd)

[7]This preferred system is the system recommended as a result of the consideration of alternative systems during the conceptual phase.

[8]This requirement should be applied only to the depth necessary to establish the conditions under which advanced development will occur. It should include consideration of the factors listed to the extent and depth that they impact on the validity of the preferred system concept. This requirement must also include consideration of the factors listed to the extent that effort during this phase impacts on the ability to define contractors commitments during a subsequent phase.

[9]This requirement reflects a statement of work for the appropriate government agency. The result of this requirement may be a statement in the RFP that "the equipment system and the support system shall be configured to reflect a minimum life cycle cost consistent with the performance requirements specified in the RFP."

[10]The system as used herein refers to the combined equipment system[5] and the logistic support system.[6]

[11]A model logistic support system segment specification is included as Appendix A to the guide to illustrate the content and format. It is intended as a design to specification of the support elements. It is developed and used during early stages of system development in lieu of detailed elemental support plans and products. The logistic support system segment specification will track the equipment design process and reflect compatible support element[14] baselines.

[12]Examples of qualitative support system requirements include the use of certain skill levels and personnel classifications, use of GFE in lieu of CFE, limitations on special training requirements, etc. Examples of quantitative support system requirements include maintenance manhour rates, mean-time-to-repair, specific limitations on repair level decisions, specific limitations of quantities of support and test equipment, etc.

[13]The preliminary ILSP should reflect only the minimum essential data as described in this statement of work. The ILSP will be expanded in subsequent phases.

[14]Support elements as used herein refer to those elements which are used in support of the equipment system, i.e., support and test equipment, supply support, transportation and handling, technical data, facilities, personnel and training.

FIGURE IV-6 (Cont'd)

[15] The corrective action system may be established by implementation of existing organizational resources and functions within the government. The corrective action system represents the transition from the development, test and production of the support system to the management, utilization and modification of the support elements under an ILS concept.

CHAPTER V

APPLICATION OF ILS TO LESS THAN MAJOR ACQUISITIONS

A. The basic principles and guidelines of Section V apply to less than major acquisitions with some modification in the depth of application. For purposes of this guide, "less than major acquisitions" refers to those acquisitions in which production of the system/equipment is preceded by a developmental phase only, or to the acquisition of off-the-shelf itmes. This section of the guide does not deal with major modifications which are treated in Chapter VI.

B. Depth of Application for Acquisitions Involving Development.

1. As indicated in Figure IV-4, the ILS prerequisite for entry into production is verification "..that the support system will permit operation and support of the equipment system within the resources planned for that purpose." The development program must therefore be structured to satisfy the task-oriented prerequisites of Figure IV-4. Similarly, the production program must be structured to satisfy the task oriented prerequisites of Figure IV-5.

2. In the absence of formal concept formulation and validation phases, some preliminary work must be performed by the government in order to establish the contract scope for the development phase. The preliminary work consists of planning the accomplishment of the task-oriented prerequisities (Figure IV-3) for entry into development. It is important to note that this preliminary work constitutes task planning as

opposed to support planning. Some tasks may be accomplished in-house prior to issuance of the development phase RFP, some may be included in the contract statement of work, and some may be screened out as unnecessary or inconsequential. The preliminary work to be accomplished is only conceptually equivalent to a composite of the model statements of work for preceding phases (Figure IV-2 and IV-3). Actual tasks which must be performed to achieve the conceptual equivalent will be determined on the basis of the complexity of support of the item and the existing support capability for the type of equipment being developed. As a minimum, support planning prior to entry into development must be sufficient to enable specification of the required support parameters and establishment of a baseline support concept. This can be accomplished by a support system specification as described in Appendix A. Figure V-1 summarizes some important considerations for the program manager in planning the accomplishment of required tasks prior to entry into development.

C. Depth of Application for Acquisition of Off-the Shelf Items

1. As indicated in Figure IV-5, the support system posture required for entry into the Deployment and Operations Phase is "support elements have been positioned and are in operation as a support system which will perform to the requirements imposed on the support system." Although this posture requirement is applicable to the acquisition of off-the-shelf items, its achievement does not require accomplishment of the task oriented

prerequisites in the same manner in which they apply to major acquisitions. Some preplanning for acquisition is essential in order to assure effective and economical support. Although the preplanning parallels the planning required in acquisitions involving development, it is aimed primarily at the procurement of needed support resources rather than at the interaction of ILS and equipment design. The program manager, in the acquisition of off-the-shelf items, should be concerned primarily with assessment of life cycle cost, utilization of existing support capability, and compatibility with existing support concepts and maintenance policies.

2. Life Cycle Cost. In off-the-shelf procurements, there is little or no opportunity for influencing the support characteristics of the item itself. There exists the opportunity to improve the economy and efficiency of ILS by examining alternative support concepts and by taking advantage of flexibilities in the design of the support system. Analytical techniques described and referenced in Chapter VII of this guide provide quantitative methods for examining alternate maintenance concepts, repair/discard criteria and life cycle costs. Wherever practical, these techniques should be applied both as evaluation techniques against candidate items or should be established as contract tasks for determining the most economical support concept.

3. Utilization of Existing Support Capability. It is essential to assure that the procurement of off-the-shelf items

include the acquisition of required support capability. Examination of existing support capability is therefore particularly important in this type of acquisition. Support resources and facilities at the operational site must be considered. When appropriate, recommendations must be made for additional equipment, facility modification, and other logistic resources to assure effective integration of the new item. The Logistic Support Analysis described in Chapters III and VII is a useful tool in determining support resource requirements for comparison with existing capability. When the analysis is included as a contracted item, it should be integrated with other analytical tasks.

4. Compatibility with Existing Support Concepts. Since the design of off-the-shelf items does not always anticipate the operational environment or support policies of the user, the acquisition process must include consideration of its compatibility with these factors.

FIGURE V-1

IMPORTANT CONSIDERATIONS IN PLANNING ILS TASKS FOR LESS THAN MAJOR ACQUISITIONS

Task Oriented Prerequisites from Figure IV-3	Important Considerations
B.1.a Definition of requirements for Built-in Test/Built-in Test Equipment and Automatic Test Equipment	Support planning is heavily influenced by both the test thoroughness and fault isolation capability of BIT/BITE. When the task for determining BIT/BITE requirements is included as a development phase contract task, the milestone for making the determination must occur as early as possible and the BIT capability must be clearly defined before definitive support planning can begin. Major impact is at the user level. Similarly, early consideration must be given to the use of automatic test equipment.
B.1.b Definition of required system maintenance characteristics	This prerequisite applies particularly to maintenance characteristics which are not subject to the trade-off process during development. Careful attention must be given to maintenance characteristics which are to be imposed as a result of austere operational environments where support capability is limited; those resulting from mobility and safety considerations; and those necessary for compatibility with existing support systems and concepts.
B.1.c Definition of required system reliability	Consideration must be given to factors affecting maintenance frequency (e.g., storage life, handling damage, test ambiguity, scheduled maintenance requirements) as well as the inherent reliability of the equipment.

Figure V-1 (Cont'd)

B.2.a Definition of quantitative contract support system requirements	Where contractual demonstration is required, quantitative requirements must be included in the development contract specifications. Appendix A provides guidance for meeting this requirement. Where demonstration is not justified, then quantitative goals should be established and trade-off criteria should be defined for inclusion in contract specifications.
B.2.b Definition of qualitative support system requirements	Preliminary tasks may be necessary to determine the applicability of existing resources such as GFE, personnel classifications, facilities and transportation, handling, and storage concepts. These determinations should allow full consideration of alternatives which may offer economic or operational advantages as the development evolves.
B.2.c Definition of Baseline Maintenance Concept	For limited development, this prerequisite applies only to the extent that the maintenance concept affects the specification of system maintenance characteristics (see C.1.b above). When the task for determining the baseline maintenance concept is deferred as a prerequisite and included as a contract task, then <u>all</u> tasks relative to support planning and logistic support system engineering must be deferred until the baseline concept is established.
B.2.d Definition of support element baselines	Contractual commitments on the acquisition of support elements should be deferred until this prerequisite is satisfied. Whether accomplished in-house or as a contracted task, the support system baseline should be defined to the depth indicated by the examples of Appendix A, Part II, prior to acquisition of support elements.

FIGURE V-1 (Cont'd)

B.3.a Definition of task-oriented plan for production and evaluation of contractor support elements	Whether accomplished in-house or as a contracted task, B2a through B2d are also prerequisites for this task in a Development program. As in major acquisitions (see Chapter III), conceptual planning for ILS is accomplished initially by the government; however, in this case, it must be preceded by conceptual formulation of support system requirements.
B.3.b Definition of baseline schedule for integration of contractor support elements with government support elements	Whether accomplished in-house or as a contracted task, B2a through B2d are also prerequisites for this task in a Development program. As in major acquisitions, conceptual planning for ILS is accomplished initially by the government; however, in this case, it must be preceded by conceptual formulation of support system requirements.

CHAPTER VI

APPLICATION OF ILS IN MODIFICATION PROGRAMS

A. The basic principles for application of ILS, Chapter III, apply in the conduct of modification programs. The method and depth of application is a function of the extent of the modification and the amount of development involved. For major modification to an existing system/equipment, the guidelines of Chapter IV are generally applicable. For minor modifications, guidelines of Chapter V are applicable. In addition, the support manager should use the checklist below to assure consideration of ILS factors which are of particular significance in modification programs:

1. If the purpose of the modification is to improve supportability of the item, is the proposed change justified by experience data?
2. Could the same or a comparable improvement be obtained by a modification in the support concept or support system without a modification to the item itself?
3. Are all support considerations included in the cost/effective justification for the modification?
4. Does the engineering change proposal include an analysis of and provisions for concurrent modification or revision to support elements?
5. Have provisions been made for concurrent verification of related modifications in the support system?

6. Have provisions been made for accounting and control of all configurations resulting from the modification?

7. Has a modification/retrofit plan been established and does it account for all support considerations and assets affected by the modification including spares, and assets in the hands of Grant Aid recipients and foreign military users?

B. Implementing Support.

The impact on support of major modification should be analyzed and determined prior to customer approval. Subsequent to approval, the support resources are acquired and delivered to operational, test and training activities affected by the major modification. Oftentimes, this requires a significant amount of ILS effort inasmuch as all elements of logistic support must be considered in a major modification program.

CHAPTER VII

QUANTITATIVE METHODS AND TECHNIQUES

Advances in the application of scientific quantitiative methods provide tools to improve the decision making process in the development of ILS requirements. The paragraphs below cover the general application of quantitative methods and techniques, a description of available techniques, and assessment of the analysis process.

The program manager must be particularly careful to relate the right technique with the problem at hand and to apply it to the depth necessary to provide the sensitivity required in arriving at a solution. In addition, he must realize that successful application is dependent on data inputs from many related areas (e.g., reliability, maintainability, human factors, life cycle costing).

A. The Benefits of ILS quantitative Methods and Techniques

ILS interrelates with the system engineering process for developing the prime mission equipment system. It commences with the identification of the basic mission and associated system requirements (e.g., operational deployment, utilization, environment, maintenance concept) and continues through functional analysis, requirements allocation, trade studies, system synthesis, detailed design, etc. Throughout this process, many decisions are made which significantly impact support as well as system life cycle cost. Inherent in these decisions are risk and

uncertainty. These factors are controlled through the appropriate and judicious use of quantitative methods and techniques in the development of support requirements (illustrated in Figure VII-1).

1. The many and varied elements associated with ILS are interrelated. The use of appropriate analytical methods allows for a logical and precise definition of the elements, the critical factors involved, and the relationships among them. There is also a clear indication of the information required in an analysis of a set of alternatives, and that which is not readily available becomes evident.

2. Decisions affecting logistic support are required in all program phases. Erroneous decisions based on inadequate data or due to the lack of appropriate analysis techniques may result in a reduction in system effectiveness and an increase in the ultimate cost of the system in the later phases. The use of appropriate analytical methods can be effectively employed to handle logistics predictions, trade-offs, assessments, etc., to a desired level of accuracy and in a timely manner.

3. The solution of problems relating to ILS involves the consideration of many alternatives in a number of different areas (e.g., operational concepts, maintenance policies, design configuration options, etc.). The use of appropriate analytical methods enables a comparison of many more possible solutions and aids in selecting the best among them rapidly and efficiently.

The employment of appropriate quantitative analytical methods and techniques can convert many complex problems to orderly patterns which can be systematically analyzed and evaluated.

B. Application of ILS Methods and Techniques

Quantitative methods can be employed in conceptual design, concept evaluation, detailed system design, logistic support planning, support effectiveness assessment, and program management. These areas are briefly covered in Figure VII-2. Each area encompasses different types of decisions involving the various elements of ILS.

Quantitative methods shall also be effectively applied to various types of programs covering:

1. Major system acquisitions. Figure VII-2 depicts typical interfaces.

2. Less than major acquisitions. This may involve the design and development of subsystems, assemblies, etc., or the procurement of off-the-shelf equipment. In this event, only one or two of the areas depicted in Figure VII-2 may apply.

C. Description of ILS Quantitative Methods and Techniques

The Logistic Support Analysis of the logistic support system segment constitutes a composite of technologies used in the definition of support requirements and the injection of support criteria into the design and acquisition process. The primary methods and techniques used are:

- Logistic Support Models (including mathematical models, simulation models, etc.)
- Life Cycle Cost Analysis
- Maintenance Engineering Analysis (MEA)

The material presented is not intended to be all inclusive but to be representative of current practices and should be considered in reviewing new approaches proposed for a specific application.

1. Logistic Support Models

A model, as used herein, is a simplified representation of the real world which addresses selected features of the situation relative to the support or performance problem being analyzed. The means of representation may vary considerably depending on the nature of the problem, and may employ any one or more techniques in the resolution of the problem. Figure VII-3 reflects an analysis approach using models. This includes the necessary feedback and corrective action loop.

Models can be quite simple and serve as a major part of the overall analysis process. The quantity of variables, number of alternatives, or the complexity of the operation may require an extensive model or a series of models. A program manager must analyze the problem at hand, select the techniques which resolve individual segments of the problem, and select or develop a model which properly employes these techniques.

Figure VII-4 presents model applications and quantitative techniques currently being used by government and industry on various programs. These models employ techniques such as: simulations, networks, Markov processes, Lagrange equations, probability and statistical distributions, stochastic, Monte Carlo sampling, dynamic programming, linear programming, queueing, regression, replacement, routing, sequencing, branch and bound, PERT/CPM, econometrics, etc. Additional examples are described in Rand report R-550-PR, "Using Logistics Models In Systems Design and Early Support Planning" and the "Catalog of Navy Systems Commands Systems Analysis/Operations Research Models," NAVFAC P-443.

Referring to Figure VII-4, a larger area of application constitutes the use of simulation techniques in solving operational analysis and logistics support problems. There are individual models currently in use which simulate a wide variety of characteristics.

2. Life Cycle Cost (LCC) Analysis

LCC analysis is a basic tool used in the evaluation of logistics resource requirements, and is employed in conjunction with other parameters, e.g., system effectiveness, technical performance, etc., in determining cost effectiveness. LCC introduces the economic data necessary for the comparison of various system/equipment design and support alternatives, and allows for the assessment of risk in the decision making process. LCC analysis serves to:

a. Define areas of high support cost as a consequence of design decisions.

b. Evaluate alternative support policies (e.g., repair versus discard-at-failure, built-in test versus external support equipment, spares level versus probability of stock-out, etc.).

c. Define impact of operational requirements on support policy alternatives.

d. Provide budget estimates for inclusion in long range cost projections and financial planning data.

e. Provide data for "make or buy" decisions.

LCC analysis may be applied to any program phase to solve a variety of problems as illustrated in Figure VII-2. LCC estimates are also used for program monitor and control, equipment procurement, and contracting. The analysis approach is depicted in Figure VII-5.

The accomplishment of LCC analysis requires:

a. Definition of the system/equipment mission objectives and associated operational requirements (e.g., applicable operational and system effectiveness factors, equipment utilization, operational life and time horizon period, deployment quantities and locations, environments, etc.).

b. Definition of the system/equipment support concept. This includes anticipated maintenance echelons, gross maintenance functions per echelon, quantitative effectiveness factors, environment, etc.

c. Allocated and/or predicted reliability, maintainability, and logistics factors and criteria for each alternative system/equipment design and support configuration being evaluated.

d. Definition of the cost breakdown structure (cost categories) to include all future systems costs covering: feasibility studies, design and development, production and test, installation and checkout, operations and maintenance, personnel and training, spare/repair parts, inventory maintenance, support and test equipment, transportation and handling, technical data, facilities, program management, and system phaseout.

e. Definition of cost factors and cost estimating relationships. This includes determination of such factors as inventory maintenance cost in terms of \$/year, cost of data in terms of \$/page, training cost in terms of \$/student week, etc.

Cost categories (item d above) must be compatible with the program work breakdown structure and cost reporting requirements. In addition, cost categories must be identified in such a manner as to reflect key activity areas plus major elements of support which are considered to have a significant affect on total system LCC. Established cost categories must be sensitive to alternate system design configurations, changes in production quantities, and various system logistics support concepts.

Costs may be categorized somewhat differently depending on the program, system involved, and funding. One method includes specifying acquisition costs and utilization costs. Another may break down R&D costs, investment costs, and expense costs.

The cost categories established should be compatible with the work breakdown structure requirements (refer to MIL-STD-881) and analysis objectives. Two examples of a cost category breakdown structure are presented in Figure VII-6.

In line with the established cost categories for a given program (Figure VII- 6 or equivalent breakdown structure), specific input cost factors must be defined. The majority of input factors for determination of R&D and investment costs are derived directly from the contractor's internal company engineering and manufacturing cost projection sheets. Input factors required for the determination of expense cost must be defined by both the government and the contractor.

The completion of LCC analyses requires that costs be obtained for each category (Figure VII-6) allocated by year over the entire program life cycle in terms of expected value (actual calculated value with inflations considered but without discounting); and calculated on the basis of present value (based on an assumed discount rate). The results will provide both a total predicted LCC figure and a cost profile for each alternative being evaluated.

Predicting costs by year is important as it allows consideration of alternate system resource requirements in terms of program planning, budgeting, and fiscal needs. Discounting refers to the application of a selected rate of interest to measure the differences in importance or preference between dollars at the present time and anticipated dollars in the

future. Discounting allows for the evaluation of the time-phased profiles of costs for various alternative systems as if they occurred at one point in time.

$$P.V. = \sum_{(t=1)}^{N} \frac{C_{CAL}}{(1+i)^t} \quad \text{where:}$$

P.V. = present value

t = time period (years)

C_{CAL} = calculated value of cost in time period $\underline{t}$

i = interest rate

N = total number of time periods in which costs occur

When completing LCC analyses, cost categories should be analyzed relative to total contribution and the validity of input cost-factor data. High contributors and/or questionable areas should be further evaluated through sensitivity analysis (e.g., using three-level estimates--pessimistic values, optimistic values, and expected values). The sensitivity analysis depicting a range of output cost values will aid in identifying the areas of risk.

LCC analysis may be approached a number of ways. Techniques are available for total systems. Several of these (e.g., Air Force's model ABLE, Navy's model SCORE, etc.) are described below:

a. ABLE (Acquisition Based on Consideration of Logistics Effect)

Computes LCC by item by cost type (storage, repair, etc.), sums for all items in the system. Could be used as an LCC model in detailed design, but is intended primarily for use as a contract incentive evaluator. Data requirements are minimal. Program input is total flying hours. Also requires item cost, reliability, maintenance cost as percent of item cost, preceding items for base and depot support equipment, NRTS and condemnation rate, on equipment maintenance man hours per operating (flying) hour, training costs, pages of technical data. Maintenance posture is standard base/depot, one indenture level. Spares are determined by ten days' base supply, ninety days' depot supply. Refer to "Project ABLE", Operations Analysis Report No. 8, May 1969, Operations Analysis Office, AFLC, WPAFB, Ohio.

b. SCORE (System Cost and Operational Resoruce Evaluation)

Estimates life cycle costs (RDT&E, investment, operations) for up to fifteen years for various component elements and aggregates these into a total cost estimate for a system. Costs may be estimated externally by the user, internally by standard CERs[1] or internally by special programs. Costs are arranged in a two-dimensional (program element x time) matrix. Program elements can be indentured, and subtotals on CERs computed for any higher level. Data requirements are moderate (work breakdown structure, various cost

1 Cost Estimating Relationship (CER)

inputs, special instruction cards). Refer to "SCORE Executive Routine, Phase I," Report No. NADC-AW-6734, February 1968, Naval Air Development Center, Johnsville, Warminster, Pennsylvania.

Examples covering less than total systems are presented in the following documents:

a. <u>LCC-1, Life Cycle Costing Procurement Guide (Interim)</u>, Government Printing Office

b. <u>LCC-2, Casebook Life Cycle Costing in Equipment Procurement</u>, Government Printing Office

3. <u>Logistic Support Analysis (LSA)</u>

LSA is the process of analyzing a given or assumed system/equipment design configuration to determine specific logistics support requirements in terms of: Maintenance functions/tasks, repair levels, spare/repair part types and quantity, personnel skills and quantity, support and test equipment, facility requirements, technical data requirements, transportability, handling/packaging requirements, etc.

LSA may be accomplished on any system or equipment and in any program phase to varying degrees of depth depending on the need and extent of system/equipment definition. Examples of application are noted in Figure III-1).

The LSA may assume different proportions. Initially in early phases of system/equipment definition, data is limited and sketchy. Allocations and gross-level predictions are necessary to accomplish the required analysis. As the program progresses, additional data (analytical data replaces prediction data, field data replaces designed analytical data, etc.)

becomes available and the analysis results are more meaningful. LSA is an iterative process with a feedback and corrective action loop and generally covers the areas illustrated in Figure VII-7.

Referring to Figure VII-7, Step 3 represents one aspect of Logistic Support Analysis, i.e., the Maintenance Engineering Analysis (MEA) data formatting as currently required for many programs. Service documents describing the MEA are noted below:

a. AMCP 700-4, NAVMAT P4000-1, AFLC/AFSCM 400-4, "Standard Integrated Support Management System (SISMS)," tri-Service.

b. AFSCM 375-5, "System Engineering Management Procedures," Department of the Air Force, Air Force Systems Command.

c. TM-38-703-3, "Integrated Logistic Support (ILS) Maintenance Engineering Analysis Data System (MEADS)," Department of the Army.

d. AR-30, "Integrated Logistic Support Program requirements for Aeronautical Systems and Equipment, Department of the Navy, Naval Air Systems Command.

e. MIL-STD-1369, "Integrated Logistic Support Program Requirements," Department of the Navy, Naval Electronic Systems Command.

f. OR-30, "Integrated Logistic Support Program Requirements," Department of the Navy, Naval Ordnance Systems Command.

g. MIL-M-24365(SHIPS), "General Specification for Maintenance Engineering Analysis Procedures and Formats," Department of the Navy, Naval Ship Systems Command.

D. Assessment of the Analysis Process

As a final step in analysis process, the program manager may wish to quickly assess the validity of the analysis. In checklist items to validate the analysis:

1. Are the goals of the analysis adequately identified?

2. Are all assumptions adequately identified?

3. Do any specified assumptions treat quantitative uncertainties as facts?

4. Are major assumptions reasonable?

5. Are any feasible or significant alternatives omitted?

6. Are the desired output measures of effectiveness (logistics evaluation criteria or quantitative figures of merit) and cost identified?

7. Is the effectiveness measure sensitive to changes in assumptions?

8. In the event that two or more effectiveness measures are appropriate, are they properly weighed?

9. Does the model adequately address the problem?

10. Are effectiveness and cost parameters linked logically?

11. Does the model allow for a timely response?

12. Does the model provide valid and reliable results?

13. Are the effectiveness and cost aspects of all alternatives treated in a consistent and comparable manner?

14. Has the sensitivity of effectiveness and cost estimates been properly addressed through a sensitivity analysis?

15. Are the areas of risk and uncertainty adequately identified?

16. Do the results fulfill the initial goals and objectives of the analysis?

The above questions apply directly to the effectiveness and efficiency in the application of quantitative techniques in the ILS process. Hopefully, they will assist the program manager in establishing a level of confidence in the analysis performed.

E. <u>Explanation of System Measures</u> - reference Figure VII-7, Step 2, Item 11.

1. <u>Inherent Availability (Ai)</u> is the probability that a system or equipment, when used under stated conditions in an <u>idea supported environment</u> (e.g., available tools, spares, manpower, etc.), shall operate satisfactorily at a given point in time. It excludes scheduled (preventive) maintenance actions, logistic supply time, and administrative downtime.

$$Ai = \frac{MTBF}{MTBF + \overline{Mct}} \quad \text{where:}$$

MTBF = mean-time-between-failure (derived from reliability prediction and covers all primary and secondary failures).

$$\mathrm{MTBF} = \frac{1}{\lambda} \quad \text{and}$$

λ represents the expected number of failures for each hour of operation (sometimes expressed in terms of expected failures per 10^6 hours of operation). MTBF is expressed in hours (total hours of operation of similar systems or components over their useful life divided by the total number of failures occurring during this time).

$\overline{\mathrm{Mct}}$ = mean active unscheduled or corrective maintenance time (arithmetic mean time for all representative maintenance tasks). This may also be expressed as mean-time-to-repair (MTTR).

$$\overline{\mathrm{Mct}} = \frac{\sum_{1}^{N} \mathrm{Mcti}}{N}$$

Mcti = individual corrective maintenance tasks.

N = quantity of corrective maintenance tasks.

2. <u>Achieved Availability (Aa)</u> is the probability that a system or equipment, when used under stated conditions in an <u>ideal support environment</u> (e.g., available tools, spares, manpower, etc.), shall operate satisfactorily at a given point in time. It excludes logistics supply time and administrative downtime. Achieved Availability (Aa) is directly relatable to the early design process (as a means of measuring equipment reliability and maintainability characteristics).

$$Aa = \frac{MTBM}{MTBM + \overline{M}} \quad \text{where:}$$

MTBM = mean-time-between maintenance covers both unscheduled (corrective) and scheduled (preventive) maintenance. Relative to corrective maintenance, MTBM considers primary (random) failures, secondary (dependent) failures, quality and manufacturing defects, operator errors, and maintenance-induced failures:

$$MTBM = \frac{1}{1/MTBMs + 1/MTBMu}$$

MTBMu is the mean interval of unscheduled (corrective) maintenance and MTBMs is the mean interval of scheduled (preventive) maintenance. In most instances, MTBMu will equal MTBF (defined above).

$\overline{M}$ = mean maintenance time or:

$$\overline{M} = \frac{(\overline{Mct})(1/MTBMu) + (\overline{Mpt})(1/MTBMs)}{(1/MTBMu) + (1/MTBMs)}$$

$\overline{Mct}$ is the mean active unscheduled (corrective) maintenance time and $\overline{Mpt}$ is the mean active scheduled (preventive) maintenance time.

3. Operational Availability (Ao) is the probability that a system or equipment, when used under stated conditions in an actual operational environment, shall operate satisfactorily when called upon. This may correspond directly with "A" in the system effectiveness expression defined below (item 6).

$$Ao = \frac{MTBM + \text{ready time}}{(MTBM + \text{ready time}) + MDT} \quad \text{where}$$

MTBM is defined and expressed above.

Ready time is that time when the system/equipment is ready for use but is not actually being utilized.

MDT = mean downtime (total time during which an equipment item is not in condition to perform its intended function). MDT includes active repair time, administrative wait time, and downtime due to logistics supply inadequacies.

4. Dependability (D). Availability as discussed above refers to the probability of a system being operable at a random point in time. However, the ability of the system to continue to perform reliably for the duration of the desired operating (mission) period is often more significant. Operation over the desired period depends on an accurate definition of the system's operating profile(s). If a system has a number of operational modes, then an operating profile for each mode must be considered. Dependability addresses this area and can be expressed as follows:

$$D = Rm + Mo\ (1 - Rm) \quad \text{where:}$$

D = system dependability or the probability that the mission will be successfully completed within mission time (ti) providing a down-time per failure not exceeding a given time (t_2) will not adversely affect the overall mission.

Rm = mission reliability or the probability that the system will operate without failure for the mission time (t_1).

$$Rm = e^{-\lambda T} \quad \text{and:}$$

$$\lambda = \frac{1}{MTBF}$$

T = mission duration (total time)

e = Napierian logarithm base or 2.71828

This expression assumes that the system has a constant failure region so that reliability can be expressed as $R = e^{-\lambda t}$.

Mo = operational maintainability or the probability that, when a failure occurs, it will be repaired in a time not exceeding the allowable downtime (t_2).

5. Capability (C). Capability covers system/equipment performance characteristics. Sometimes, certain characteristics can be expressed in terms of a probability (e.g., missile target accuracy--Circular Error Probability). Other times, a set of characteristics, all in different units of measure, are significant and applicable. In this instance, such requirements (the combining of which would create an "apple-orange" mixing effect) are assumed as having been met through the design process and the capability expression either is not employed or is assigned a factor of 1 in the system effectiveness formula defined below. Capability may be expressed differently depending on the system/equipment operational requirements.

6. System Effectiveness (S.E.)

System effectiveness can be defined as" "the probability that a system can successfully meet an operational demand within a given time when operated under specified conditions" or, "the ability of a system to do the job for which it was intended."

The aspect of system effectiveness can be approached in a number of ways even though the ultimate objective is the same. One accepted approach specifies system effectiveness as a function of availability, dependability, capability, and utilization and can be expressed as follows:

S.E. = (A) (D) (C) (U) where:

(1) Availability (A) - a measure of the degree to which a system is in the operable and commitable state at the start of a mission when the mission is called for at an unknown random point in time. This is often called operational readiness.

(2) Dependability (D) - a measure of the system operating condition at one or more points during the mission, given the system condition at the start of the mission (availability). This is often called mission reliability.

(3) Capability (C) - a measure of the ability of a system to achieve its mission performance objectives, given the conditions during the mission (dependability). This is sometimes called performance or design adequacy.

(4) Utilization (U) - an adjustment or degradation factor employed in the event that stresses are imposed on the system as a result of using the system in a mission profile or environment more stringent than the one for which the system was initially designed. If the system is utilized beyond what was originally intended, there will undoubtedly be a degrading effect on availability, dependability and capability.

The capability element in the above expression covers those parameters where the greatest degree of emphasis has been placed in the design process in the past (e.g., performance characteristics). The other elements which include the aspects of reliability, maintainability, logistics support, human factors, quality control, etc., have not been adequately considered.

Additional approaches for system effectiveness are:

(1) S.E. = (Performance) (Availability) (Utilization)

(2) S.E. = (Operational Readiness) (Mission Reliability) (Design Adequacy)

7. Cost Effectiveness

Cost effectiveness relates to the measure of a system in terms of mission fulfillment (system effectiveness) and total life-cycle cost. Cost effectiveness (which is similar to the standard cost-benefit analysis approach often employed for decision-making purposes) can be expressed in various terms depending on the specific mission or system parameters that one wishes to measure. True cost effectiveness is impossible to measure since there are many factors that influence the operation

and support of a system which cannot realistically be quantified (e.g., system interaction effects as a result of other systems, political implications, certain environmental factors, etc.). Thus, it is common to employ specific cost effectiveness "figures-of-merit" (FOM) such as:

$$\text{C.E. FOM} = \frac{\text{System Effectiveness}}{\text{Total Life-Cycle Cost}} \quad \text{and}$$

$$\text{C.E. FOM} = \frac{\text{MTBM}}{\text{Total Life-Cycle Cost}}$$

System effectiveness and MTBM (Mean-Time-Between-Maintenance) are discussed above. Total life-cycle cost is defined below.

8. Total Life-Cycle Cost

Total life-cycle cost includes all future costs associated with the system.

a. Acquisition Cost

(1) Research and Development (R&D) - feasibility studies; initial design and development; fabrication, assembly, and test of engineering/prototype models; initial system evaluation; and associated documentation.

(2) Investment - fabrication, assembly, and test of operational systems (production models); and associated initial logistics support requirements (e.g., support equipment design and development, spares provisioning, technical data, training, entry of items into the inventory, facility construction, etc.).

b. Utilization Cost

(1) Operation and Maintenance (O&M) - sustaining personnel and maintenance support, spare/repair parts, support

equipment maintenance, transportation and facilities, modifications and technical data changes, etc.

(2) System Phase Out - phase-out of the system from the inventory due to obsolescence or wearout.

Costs may be broken down many ways depending on program requirements.

9. Maintenance man-hours per system/equipment operating hour (MMH/OH).

10. Maintenance man-minutes per system/equipment operating hour (MMM/OH).

11. Maintenance man-hours per year for all systems/equipments (MMH/YR).

12. Cost per system/equipment operating hour (Cost/OH). Cost may be expressed in terms of Operation and Maintenance cost, maintenance cost only, or total cost.

13. Mean-time-between-failure (MTBF) is defined above.

14. Mean-time-between-demand (MTBD) refers to the demand interval for spares which is the reciprocal of the demand rate. Demand rates are often based on a poisson distribution.

15. Mean-time-between-maintenance (MTBM) is defined above.

16. Mean-time-to-repair (MTTR) is the same as $\overline{Mct}$ defined above. MTTRG is the geometric mean-time-to-repair, or equipment repair time (ERT), or the median value of all repair times.

17. $\overline{Mpt}$ is the mean-active maintenance time for all scheduled or preventive actions.

$$\overline{Mpt} = \frac{\sum_{1}^{N} Mpti}{N}$$

Mpti = individual scheduled or preventive maintenance tasks

N = quantity of scheduled or preventive maintenance tasks

18. Maximum maintenance time (Mmax) refers to the repair time represented at the 90th or 95th percentile point on a log-normal or skewed distribution.

19. Self-test thoroughness may be defined a number of ways. However, a common approach is to relate the number of parts in the system/equipment which, when failed will cause a detectable no-go indication at the system level to the total number of parts in the system/equipment. When all parts are covered by the self-test capability, 100% self-test thoroughness is assumed.

FIGURE VII-1

NEED FOR ILS QUANTITATIVE METHODS

° MANY INTERRELATED ELEMENTS

- √Design considerations (Reliability & Maintainability)
- √Support & Test Equipment
- √Supply Support
- √Facilities
- √Personnel & Training
- √Technical Data
- √Transportation/Handling
- √Cost Information

° MUST CONSIDER ALL AS AN INTEGRATED SYSTEM--NOT ON AN INDIVIDUAL BASIS

° MUST DEFINE CRITICAL FACTORS, SENSITIVITIES, AND MEASURE INTERRELATIONSHIPS

° LOGISTICS DECISIONS ARE REQUIRED IN ALL PROGRAM PHASES

- √Conceptual
- √Development
  - (Conceptual and Development: Program Initiation)
- √Full Scale Development
- √Production
- √Deployment/Operations

° QUANTITATIVE METHODS ARE REQUIRED TO MAKE NECESSARY ALLOCATIONS, PREDICTIONS, AND ASSESSMENTS

° RESULTS MUST BE VALID, REPEATABLE, AND TIMELY

° MANY DECISIONS ARE REQUIRED

° MANY POSSIBLE ALTERNATIVES MUST BE CONSIDERED FOR A GIVEN PROBLEM DECISION IN EACH AREA CONCERNING:

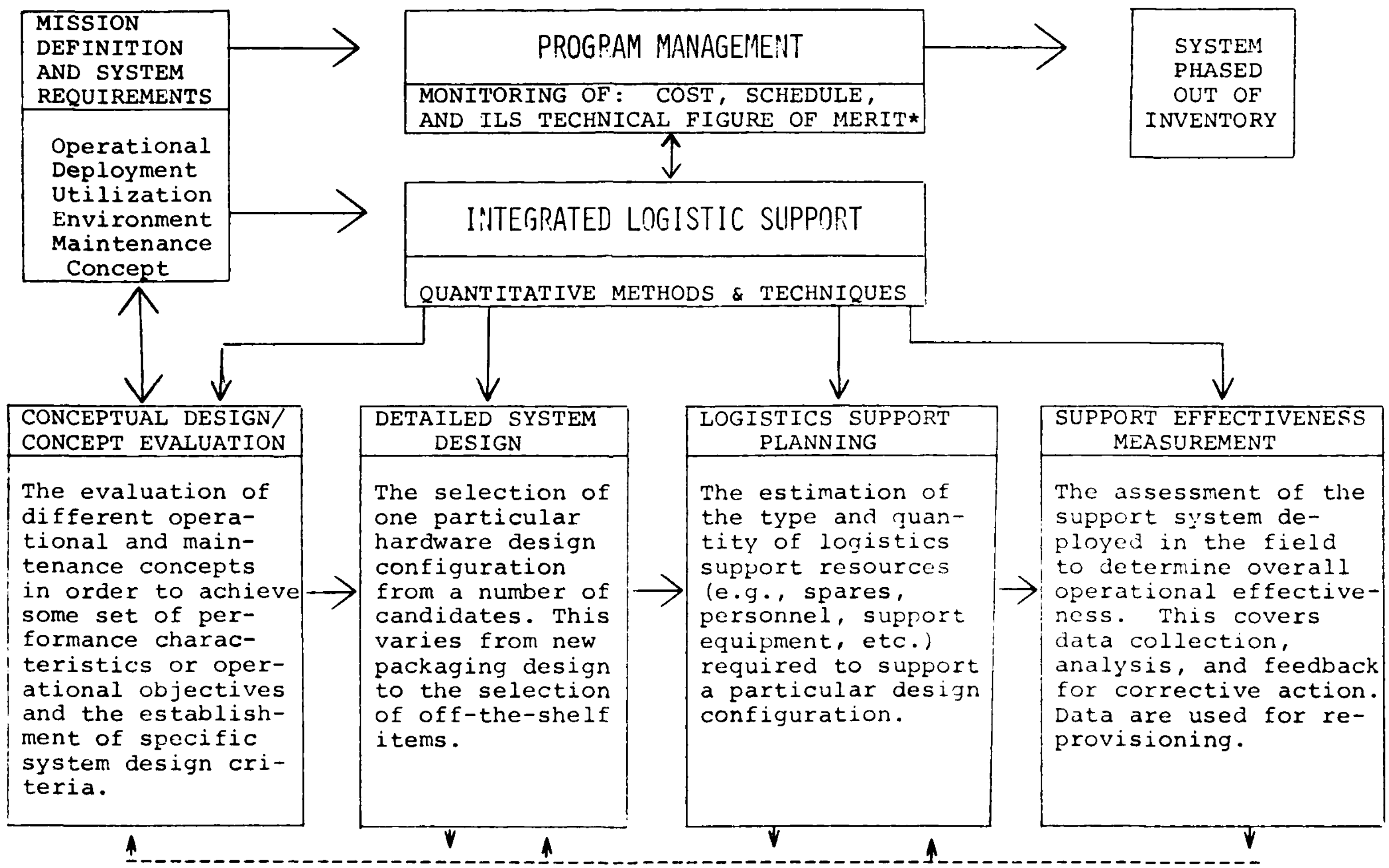
- √Operational Concepts & Maintenance Policies
- √Design Configurations
- √Definition of Support Requirements
- √Management Plans

° REQUIRES RAPID AND SYSTEMATIC METHOD TO ASSESS BOTH COST AND EFFECTIVENESS

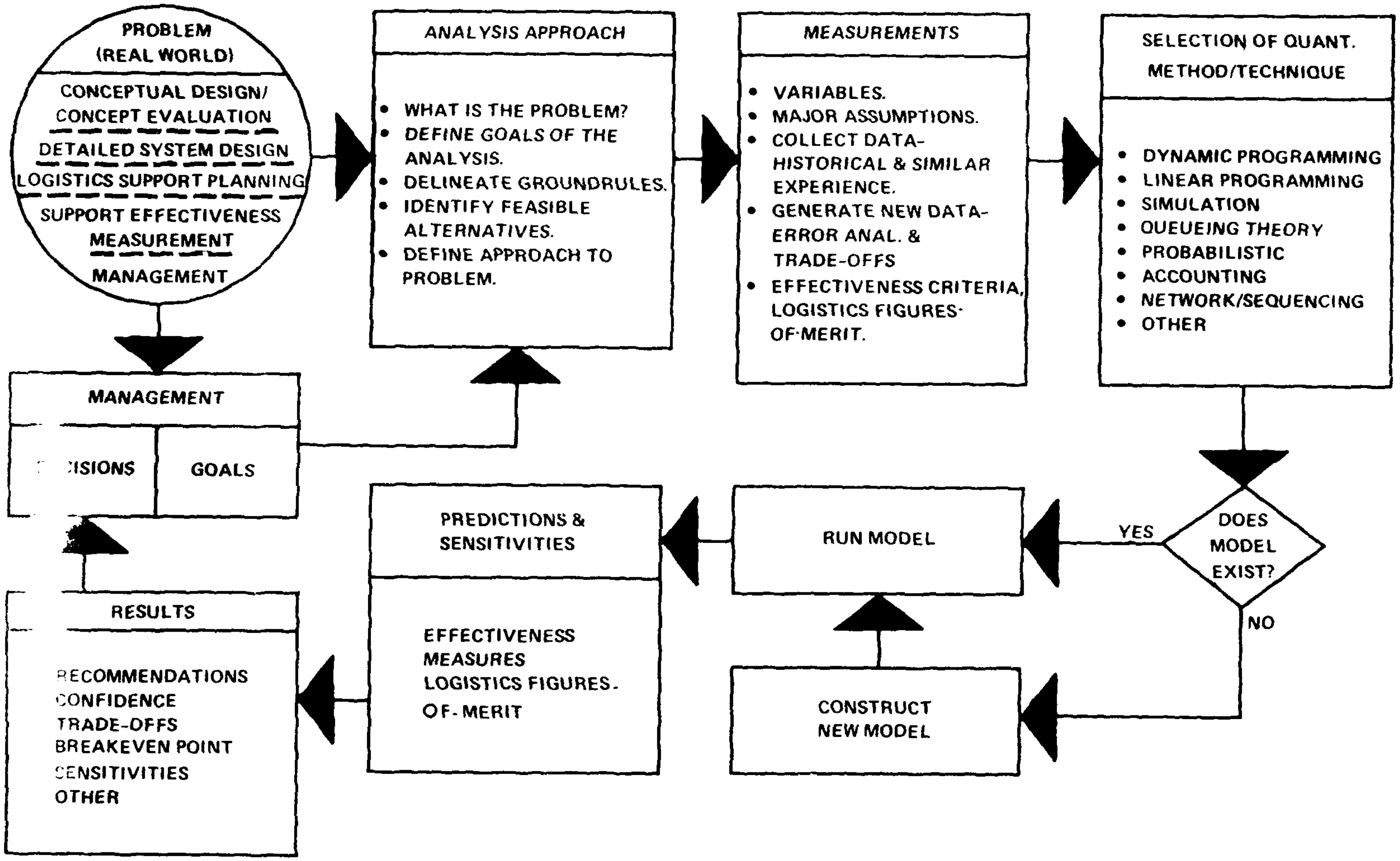
ACCOMPLISHED THROUGH ILS QUANTITATIVE METHODS

FIGURE VII-2

APPLICATION OF ILS QUANTITATIVE METHODS



* Figures-of-merit refer to logistics quantitative measures (criteria) applicable to a given program.



NOTE: THIS PROCESS IS ITERATIVE COMMENCING IN THE CONCEPTUAL PHASE AND EXTENDING THROUGH DEVELOPMENT AND PRODUCTION.

FIGURE VII-3 ANALYSIS APPROACH (FOR ANY GIVEN PROBLEM)

FIGURE VII-4

TYPICAL LOGISTICS SUPPORT MODELS AND THEIR APPLICATIONS*

MODEL	APPLICATION	DESCRIPTION OF FUNCTION	METHOD/TECHNIQUE
1. Operations Analysis and Logistics (Typical)	Conceptual design and logistics support planning -- Employed in conjunction with life cycle cost in cost effectiveness evaluations and for program management applications (scheduling, resource allocation)	Simulates aircraft operational events (alert requirements, sortie-generation capabilities, readiness postures) and associated logistics support requirements for one or more aircraft at one or more bases. Takes into account weather, resource shortages, flying schedules, alert commitments, abort rates, attrition, and related changes in concepts, policies, resource mines, etc. Refer to RM-4923-PR, "User's Manual for SAMPSON II"(Air Force). --- Simulates overall operations and support functions at one or more bases and a depot. Can handle aircraft or missiles and their component parts. Refer to RM-4923-PR, "User's Manual for SAMPSON II" (Air Force). --- Simulates overall operations and support functions at a single airbase. Includes flying of aircraft, servicing tasks, maintenance action rates, spares, personnel, utilization and interaction of maintenance resources, etc. Refer to RM-5544-PR, "The Logistics Composite Model: An Overall View (Air Force). ---	Simulation supported by the use of other techniques in solving specific segments of the overall problem.

FIGURE VII-4 (Cont'd)

		Simulates unscheduled and scheduled maintenance of a system at organizational, direct, and general support levels of maintenance. Can handle systems characterized by missions of any duration and supported by any mix of maintenance policies. Refer to AMCP 750-2, "Army Organizational Maintenance Simulation Model." (Army)	
		Calculates the minimum cost operational readiness float allocations which enable the float to meet a specified control for the support system. Refer to AMCP 750-6, "Techniques for determining Optimal Operational Readiness Float." (Army)	
		Simulates flight operations, maintenance policies, support functions, and resource allocation. Transforms a flight schedule, aircraft reliability and maintainability characteristics, and initial logistics support levels (personnel, spares) into aircraft performance figures-of-merit (readiness, maintenance manhours, etc.). Refer to NADC-SD-6904, "VALUE IV: An Aircraft Simulation Model" (Navy).	
2. Level of Repair Analysis (LORAM)	Detailed system design and logistics support planning	Evaluates alternative support postures (discard-at-failure, accomplish local repair, or repair at depot) in terms of total logistics cost. Also allows for	Accounting and/or network

FIGURE VII-4 (Cont'd)

		trade-off evaluation of any two or more ILS parameters (e.g., total logistics cost, support equipment by echelon of maintenance, NOR rates, various logistics times, etc.). Input data include: operational factors, maintenance action rates, maintenance times, maintenance costs, base loading. Refer to AR-60, "Level of Repair for Aeronautical Material" (Navy).	
3. Optimum Repair Level Analysis (ORLA)	Detailed system design and logistics support planning	Evaluates alternative support postures (discard-at-failure, intermediate level repair, or depot level repair) in terms of total logistics cost. Also allows for trade-off ev luation of any two or more ILS parameters (e.g., total logistics cost, support equipment by echelon of maintenance, various logistics times, etc.). Input data include: operational factors, maintenance action rates, maintenance times, base loading, and maintenance costs. Refer to AFLCM/AFSMC 375-6, "Optimum Repair Level Analysis" (Air Force).	Accounting and/or network
4. Subsystem Analysis (Typical)		Computes downtime of submarine-based ballistic missiles due to a shortage of spares. Refer to Report No. 67TMP-123, "A Multi-Echelon Markov Model for Relating Supply System Performance to Fleet Readiness" (Navy).	Markov Chain

FIGURE VII-4 (Cont'd)

		Determines optimum types and quantities of spares for the support of a deployed unit, subject to multiple constraints. Also computes supply effectiveness in terms of "probability of no stockout" or "expected time to stockout." Spares Kit Evaluator Model (Air Force).	Simulation
		Computes the optimal levels and allocation of spare items in a base-depot supply with compound Poisson demand, with back orders as the supply effectiveness criterion. Refer to RM-5078-PR, "METRIC: A Multi-Echelon Technique for Recoverable Item Control" (Air Force).	LaGrange multiplier
		Computes maintenance manpower and support equipment requirements, taking into account the randomness of the failure pattern, the work-shift policy, and the cost effectiveness trade-off. Refer to RM-3308-PR, "Determining Economic Quantities of Maintenance Resources" (Air Force).	Queueing theory
5. Effectiveness	Concept evaluation	Evaluate effectiveness parameters in forms of rehability with and without repair; instantaneous and steady state availability; interval reliability with and without repair; restore time distribution; mean uptime and mean downtime; repairmen utilization; repairmen shortage; and effective failure	Markov Chain

FIGURE VII-4 (Cont'd)

		and restore rates. Refer to Generalized Effectiveness Methodology (GEM) User's Manual, TD-114, Naval Electronics Laboratory Center, San Diego, California 92152.	
6. PERT/CPM	Program management (scheduling, program evaluation) -- Employed in conjunction with cost data to give cost/schedule monitor and control	Basic program management technique applicable to any project to facilitate task-schedule control and program evaluation. Generally applied to the project as a whole and requires inputs to include tasks, task times, and task interrelationships for each of the major logistics elements--maintenance planning, support and test equipment, supply support, transportation and handling, technical data, facilities, personnel and training, and ILS management functions.	Network/sequencing

* The models listed represent only a sampling of current analytical approaches used to solve different problems.

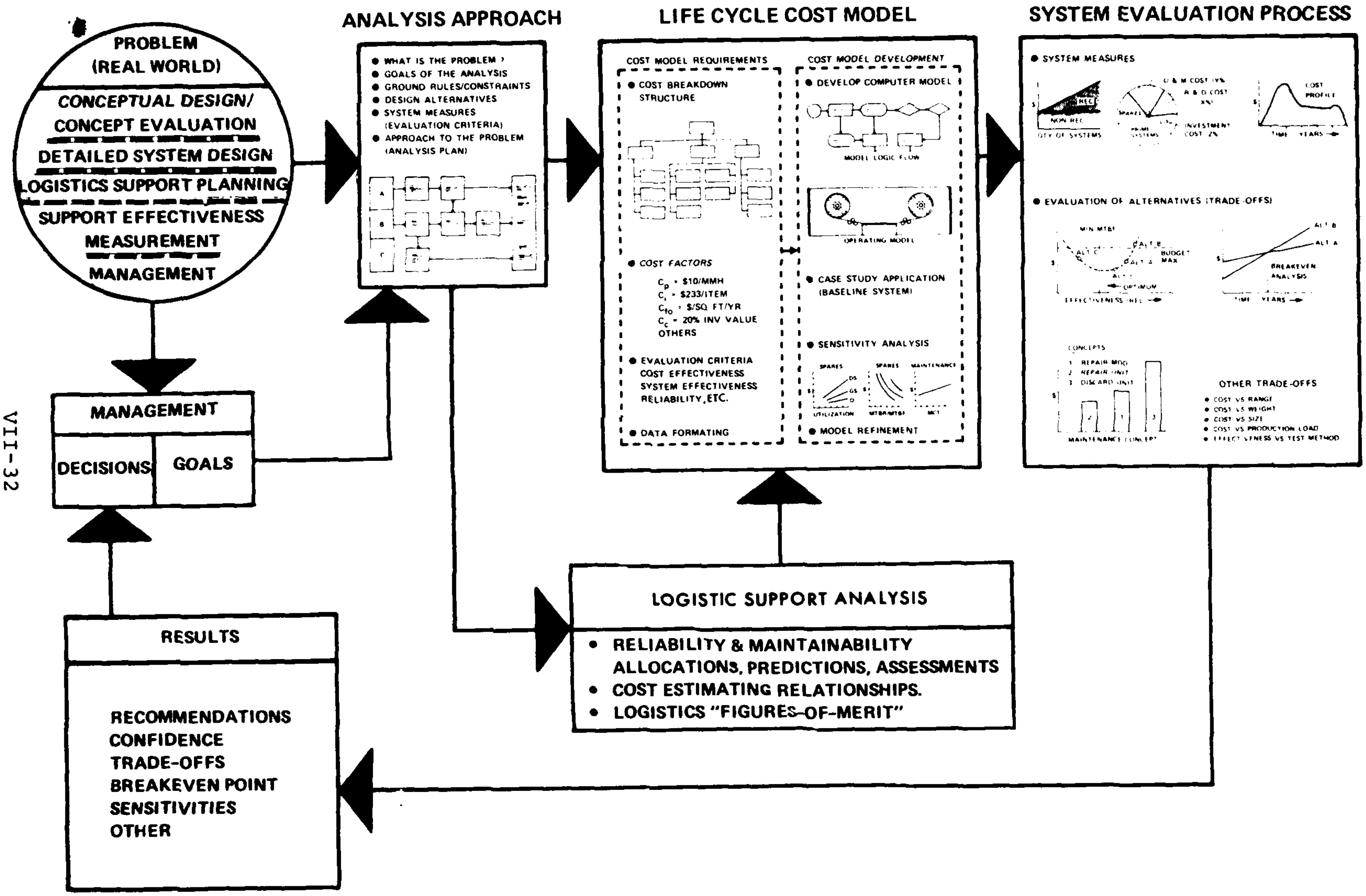


FIGURE VII-5 LIFE-CYCLE COST ANALYSIS APPROACH

FIGURE VII-6
COST BREAKDOWN EXAMPLE A

- TOTAL SYSTEM COST 000000 C
  - RESEARCH & DEVELOPMENT A10000 C_R
    - PROGRAM MANAGEMENT A21000 C_{RM}
    - ADVANCED RESEARCH & DEV A22000 C_{RR}
    - ENGINEERING DESIGN A23000 C_{RE}
      - SYSTEMS ENGINEERING A33100
      - ELECTRICAL DESIGN A33200
      - MECHANICAL DESIGN A33300
      - MICROELECTRONICS A33400
      - RELIABILITY-A33500
      - MAINTAINABILITY-A33600
      - HUMAN FACTORS-A33700
      - COMPONENTS-A33800
      - SUPPLIER-A33900
      - TRANSPORTABILITY
      - STANDARDIZATION
    - EQUIPMENT DEVELOPMENT A24000 C_{RD}
      - PROTOTYPE PRODUCTION A34100
        - °MFGRG LABOR-A44110
        - °MATERIAL-A44120
      - ENGRG TEST & EVALUATION A34200
    - DOCUMENTATION A25000 C_{RT}
  - INVESTMENT B10000 C_I
    - MANUFACTURING B21000 C_{IP}
      - FIXED NON-RECURRING B31100 C_{IM}
        - MFGRG., ENGINEERING B41110
        - SYSTEM INTEGRATION B41120
        - ENGINEERING CHANGES B41130
        - QUALITY ASSURANCE B41140
        - QUALIFICATION TEST B41150
        - PRODUCTION SAMPLING TEST - B41160
        - TOOLS & TEST EQUIP. B41170
        - FACILITIES-B41180
        - DOCUMENTATION B41190
      - RECURRING PRODUCTION B31200 C_{IR}
        - ASSEMBLY & TEST B41210
        - MATERIAL/INVENTORY B41220
        - SUSTAINING ENGINEERING-B41230
        - QC & INSPECTION B41240
        - INITIAL PACKAGING & TRANSPORTATION (1st. Dest.)-B41250
    - PROGRAM MANAGEMENT B22000 C_{IM}
      - PLANNING, ADMIN. & CONTROL-B32100
    - LOGISTICS SUPPORT B23000 C_{IL}
      - ILS MANAGEMENT B33100
      - SPARES PROVISIONING B33200
      - INITIAL INVENTORY MGMT.-B33300
      - SUPPORT EQUIP. & TOOLS-B33400
      - TECH. PUBLICATIONS B33500
      - INITIAL TRAINING B33600
        - °OPER. TNG.-B43610
        - °MAINT.TNG.-B43620
        - °TNG.DEVICES/AIDS B43630
      - INSTL. & CHECKOUT B33700
      - CONTRACTOR SUPPORT B33800
      - R & M DATA-B33900
  - OPERATIONS & MAINT. C_O
    - OPERATIONS C21000 C_{OO}
      - OPERATIONAL PERSONNEL C31100 C_{OP}
      - OPERATIONAL TRAINING C31200 C_{OT}
      - OPERATIONAL FACILITIES C31300 C_{FO}
    - SYSTEM PHASEOUT C23000 C_{VD}
    - MAINTENANCE C22000 C_M
      - MAINTENANCE, PERSONNEL & SUPPORT C32100 C_P
        - ORGANIZATIONAL-C42110
        - DIRECT SUPPORT-C42120
        - GENERAL SUPPORT-C42130
        - DEPOT - 42140
      - SPARE/REPAIR PARTS C32200 C_S
        - ORGANIZATIONAL-C42210
        - DIRECT SUPPORT-C42220
        - GENERAL SUPPORT-C42230
        - DEPOT - C42240
      - SUPPORT EQUIP. MAINT. C32300 C_{SE}
      - TRANSPORTATION/HANDLING/PACKAGING C32400 C_{TT}
      - MAINTENANCE TRAINING C32500 C_{MT}
      - MAINTENANCE FACILITIES C32600 C_{FM}

NOTE: Cost categories must be compatible with program work breakdown structure and cost reporting requirements and must be sensitive to analysis objectives.

FIGURE VII-6
COST BREAKDOWN STRUCTURE EXAMPLE B

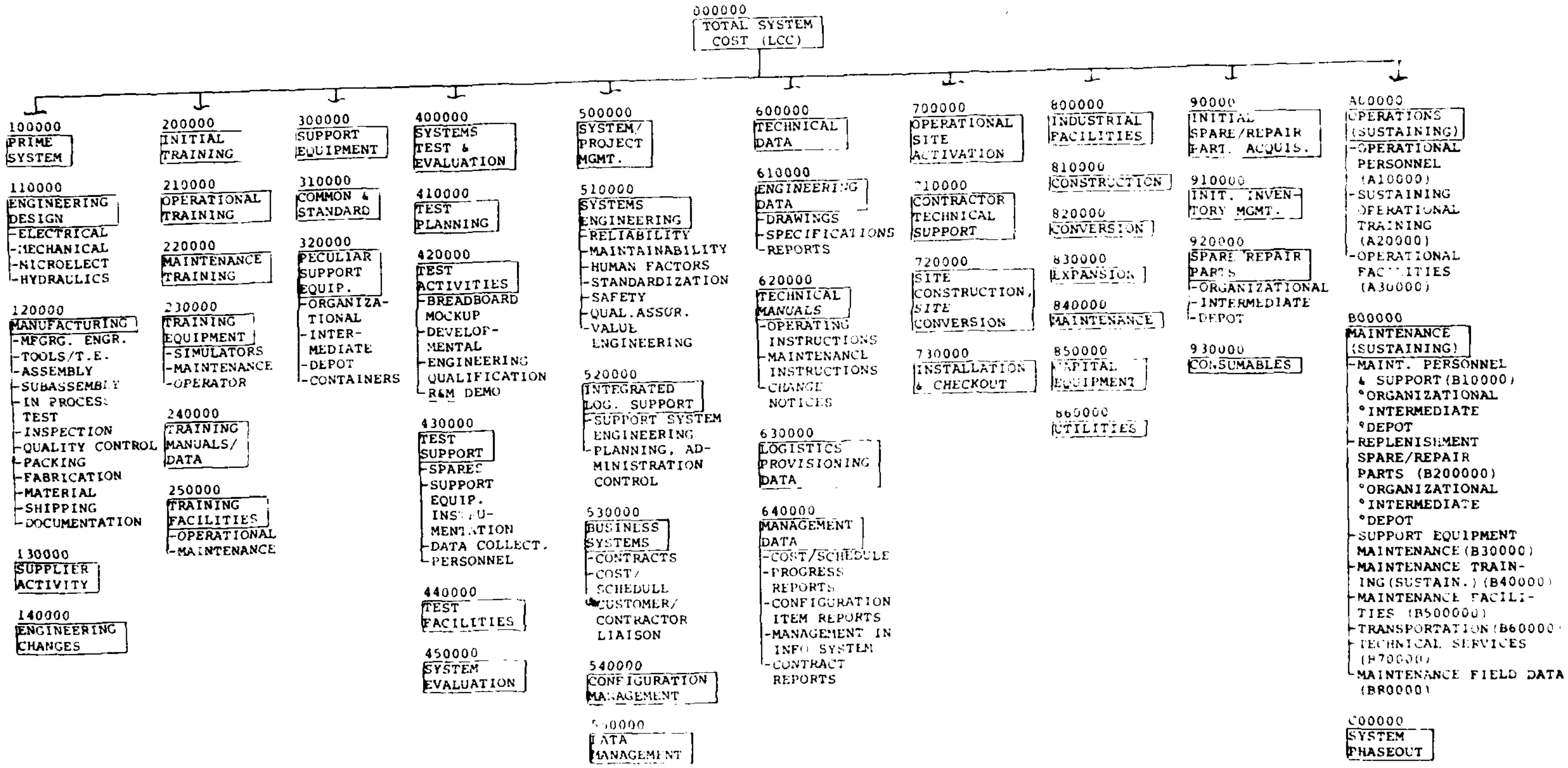


FIGURE VII-7
LOGISTIC SUPPORT ANALYSIS PROCESS

STEP 1

LOGISTIC SUPPORT ANALYSIS-INPUT FACTORS (TYPICAL)

1. ITEM NOMENCLATURE
2. WBS IDENTIFICATION
3. MISSION PROFILE
4. SMR CODE
5. OPERATIONAL LIFE
6. MAINT. ECHELON (LEVEL)
   . ORG., INT., DEPOT, MFGR.
7. MAINT. REQMT.-PREPARE, INSP., SERVICE, REPAIR, REMOVE, TEST, OVERHAUL, CALIB., ETC.
8. PERSONNEL REQMTS/TASK
   a. SKILL LEVEL
   b. QUANTITY/SKILL
   c. UTILIZATION
   d. COST/MAN-HR.
9. REPLACEMENT PARTS
10. CONSUMABLES (POL)
   a. ITEM NOMENCLATURE
   b. ITEM QUANTITY
   c. ITEM ACQUIS. COST
11. SUPPORT EQPMT. & TOOLS/TASK
12. DOCUMENTATION
   a. TYPE OF DATA
   b. QTY. OF DATA SHTS
   c. COST/DATA SHEET
13. STANDARD COST FACTORS
   a. COST OF TRANSPORTATION
   b. COST OF TRAINING
   c. COST OF FACILITY SPACE
   d. COST OF RESOURCES
   e. COST OF INVENTORY MAINT.
   f. COST OF SUPPORT EQUIP. MAINT. DATA
   g. COST OF MATL. PROVISIONING
   h. COST OF DISPOSAL
   i. COST OF MAINT. DATA
   j. DISCOUNT RATE, ESCALATION FACT
14. CLIMATE
   ARTIC, DESERT, MOUNTAINOUS, ETC.
15. DEPLOYMENT
   OVERSEAS OR CONUS

NOTE: THESE FACTORS ARE DERIVED MANUALLY BY AN ANALYST WHEN EVALUATING A GIVEN DESIGN CONFIG. THEY SHOULD BE APPLICABLE AND COMMON TO ANY MEA PROCESS INDEPENDENT OF CUSTOMER & SPECIFICATION.

OPERATIONAL REQUIREMENTS & SYSTEM EFFECTIVENESS QUANTITATIVE REQUIREMENTS & BASIC DESIGN DATA

ACQUISITION COST VALIDATION DATA

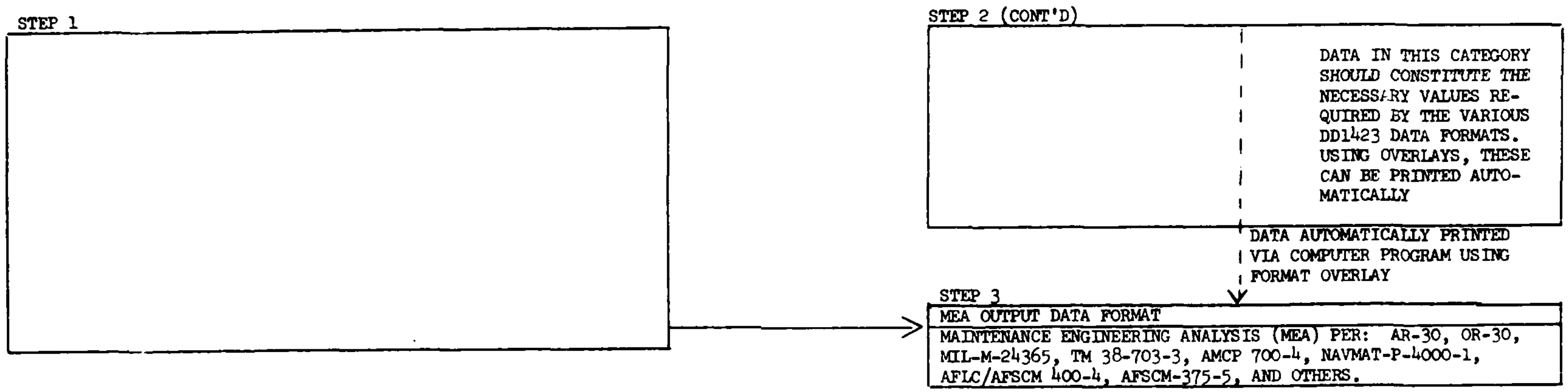
STEP 2

LOGISTIC SUPPORT ANALYSIS-SYSTEM MEASURES

1. DATE
2. ITEM NOMENCLATURE
3. MFGR. PART NO.
4. NEXT HIGHER ASSY.
5. QTY./NHA
6. WORK UNIT CODE
7. WBS IDENTIFICATION
8. SPECIFICATION NO.
9. MAINT. CONTROL NO.
10. MAINT. SUPPORT RQMTS. BY ECHELON (LEVEL)
   a. SPARE/REPAIR PTS.
      (1)TYPE(NOMENCLA.)
      (2)QTY./TYPE
      (3)COST OF SPARES
   b. PERSONNEL
      (1)TYPE(SKILL LEVEL)
      (2)QTY./SKILL
      (3)UTILIZATION
      (4)PERSONNEL MAINT.COST
      (5)OPER.PERSONNEL COST
   c. TRAINING
      (1)TYPE/TRAINING
      (2)QTY,STUDENTS/TIME
      (3)COST OF TRAINING
      (4)COST, TNG. EQUIP.
   d. SUPPORT EQUIP & TOOLS
      (1)TYPE(NOMENCLA.)
      (2)QTY./TYPE
      (3)COST,SUPPORT EQUIP. (ACQUIS. & MAINT.)
      (4)UTILIZATION FACTOR
   e. FACILITIES
      (1)MAINT. SPACE
      (2)SUPPLY SPACE
      (3)RESOURCES
      (4)COST OF FACILITIES
   f. TECHNICAL DATA
      (1)TYPE OF DATA
      (2)COST OF DATA
   g. TRANSPORTATION, HANDLING, & PACKAGING COST
11. SYSTEM MEASURE (INDICES)--ALLOCATED,PREDICTED,MEASURED
   a. Ai,Aa,Ao,D,C
   b. SYSTEM EFFECTIVENESS
   c. TOTAL COST
      (1)ACQUIS. COST
      (2)UTILIZATION COST
   d. COST EFFECTIVENESS
   e. MMH/OH,MMM/OH,MMH/YR
   f. COST/OH, COST/YR
   g. MTBF
   h. MTBD
   i. MTBM
   j. MTTR, MTTRG
   k. MPT
   l. Mmax,CONFIDENCE LEVEL
   m. M
   n. MDT
   o. SELF TEST THOROUGHNESS

NOTE: THESE PARAMETERS ARE SYSTEMS MEASURES, SUMMARY OF TOTAL MAINT.REQMTS, ETC., FOR A GIVEN SYSTEM. THEY SHOULD BE DERIVED AUTOMATICALLY FROM THE MEA INPUT FACTORS PROVIDED BY THE ANALYST.

FIGURE VII-7 (Cont'd)



CHAPTER VIII

RELATED DISCIPLINES

A. ILS elements interface with many facets of program management as well as various technically oriented disciplines involved in system design, development, production and test process:

1. Support engineering personnel provide an input to system design through the maintainability/reliability requirements and the specification of quantitative and qualitative logistics support criteria.

2. ILS considerations (e.g., preliminary Logistic Support Analysis) provide an important input in the accomplishment of of system trade-offs.

3. With a preferred design configuration selected, support engineering data are employed to determine specific support requirements.

4. Once support requirements have been defined, the acquisition process commences. ILS activities include the preparation of operating and maintenance instructions (e.g., technical manuals) to support the system throughout its life cycle. Also, other elements of ILS are acquired (through design, fabrication, production, and/or direct off-the-shelf procurement). The elements of ILS provide support for system evaluation testing as well as operational use.

5. Throughout the system life cycle, ILS data are collected, analyzed, and used to assess total system operational effectiveness.

This may lead to proposed system design changes which in turn require a new iteration (for areas affected by the change) of the earlier ILS functions.

B. ILS activities cover all program phases and the interfaces are many and varied. Specific areas of involvement are depicted in Figure VIII-1 and discussed further in Table VIII-1.

C. Referring to the information presented, the extent of interface between ILS and the disciplinary areas noted may vary depending on the nature of the system, the type of procurement, and contractual requirements. Certain specific interfaces may be emphasized or de-emphasized in some instances. In addition, other areas may become significant through variations in program requirements. In most cases, however, those interfaces noted in the figure/table are applicable and must be considered in the successful implementation of an effective ILS program.

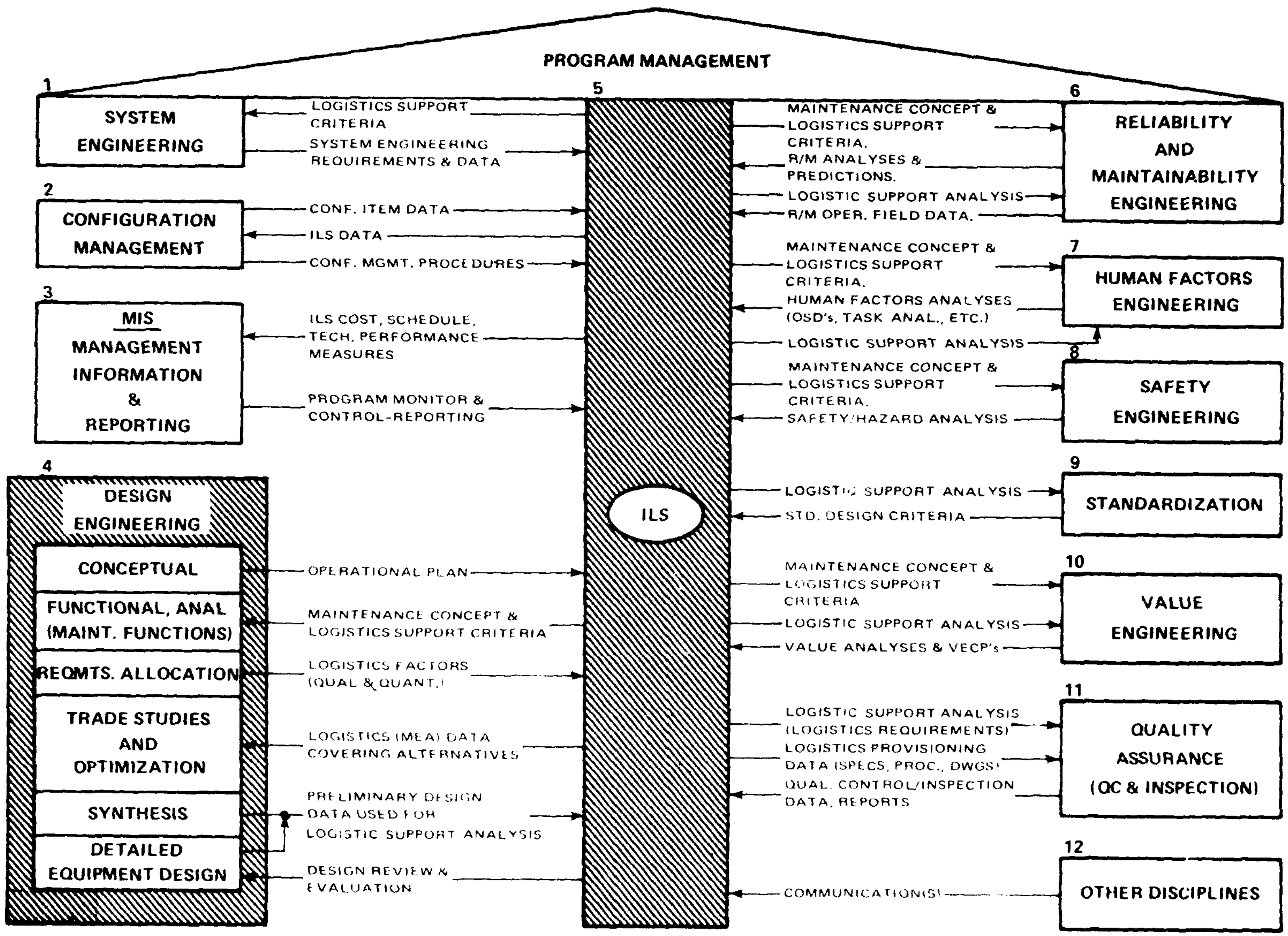


FIGURE VIII-1 MAJOR ILS INTERFACES

FIGURE VIII-2

DESCRIPTION OF MAJOR ILS INTERFACES*

INTERFACE AREA	INTERFACE RELATIONSHIP
1. Systems Engineering (Refer to Figure VIII-1, Block 1)	ILS planning impacts upon and in turn is impacted by the system engineering process activities throughout a system life cycle. Initially, support system descriptions in the form of criteria and constraints are furnished with the top level system operational requirements. These descriptions are then continually and progressively refined and expanded as the life cycle progresses. The system engineering process, in its evolving of functional and design requirements, has as its goal the achievement of proper balance between operational, economic and logistics factors. This balancing (and integration) function is an essential part of the system/cost effectiveness trades and studies. Normally, the lower level ILS descriptors will influence and be influenced by the qualitative and quantitative maintainability and reliability parameters. These descriptors will include such items as basing concepts, personnel or training constraints, repair level constraints, and similar support system considerations. Thus the integration of ILS and planning considerations into the system engineering process is continuous and iterative activity with the output being a set of detailed support system requirements and constraints.
2. Management Information (Refer to Fig. VIII-1, Block 23)	Program cost, schedule, and technical performance measures are reviewed and evaluated (from the standpoint of program monitor and control) through the management information system. All elements of ILS should be reflected on the

FIGURE VIII-2 (Cont'd)

2. Management Information (Refer to Fig. VIII-1, Block 3) (Cont'd)	contract work breakdown structure, applicable program networks, etc., and should be monitored and controlled. This includes logistics technical figures-of-merit predicted at predetermined points throughout the program.
3. Configuration Management (Refer to Fig. VIII-1, Block 2)	Fundamental to the management of any program is the use of a series of Configuration Management baselines which assure an orderly interface from one major decision point to the next in the system life cycle. The ILS process interfaces with Configuration Management through development of technical data which affects the planned logistic support resources. These data are evaluated at critical design reviews scheduled throughout the program (e.g., conceptual preliminary design review, critical design review, etc.). As the configuration baselines are refined, the logistic baseline must be adjusted, i.e., quantitative goals, preliminary maintenance concepts, and logistic plans. The logistic support requirements delivered in support of initial operational equipment is adjusted to match the product baseline established at Physical Configuration Audit. It must be recognized that subsequent Configuration Management Decisions almost always impact the logistic support system. Recognition of these impacts and adjustments to the support system must be achieved concurrent with the design changes to assure concurrent support.
4. Design Engineering (Refer to Fig. VIII-1, Block 4)	ILS employs the systems approach in covering the activities to be accomplished and the procedures to be followed in the definition, design, and development, provisioning, and acquisition, production and test, delivery, and operation of logistics support requirements. Certain outputs of ILS activities (e.g., maintenance concept definition, logistics effectiveness criteria and predictions, support engineering analysis, etc.) provide input to the design engineering process (operational plan, functional analyses)

FIGURE VIII-2 (Cont'd)

4.	Design Engineering (Refer to Fig. VIII-1, Block 4) (Cont'd)	and trade-studies, prime equipment system design data) provide input to ILS. The ILS-design engineering interactions are many, varied, and continuing, particularly in the early phases of a program-conceptual and development.
5.	Reliability and Maintainability Engineering (Refer to Fig. VIII-1, Block 6)	Such criteria are converted to qualitative and quantitative reliability and maintainability inputs to the system analysis and design process. Given a particular design and configuration, reliability and maintainability analyses and predictions (block diagrams, failure-made-effect-analysis, MTBF, MTBM, MTTR, M, MMH/OH, etc.) form the basis for determining maintenance and logistics support requirements as developed through the logistic support analysis process. During test and evaluation, reliability tests and maintainability demonstrations assist in the validation of various logistics support elements -- ensures compatibility between prime equipment and support equipment, verifies technical manuals, verifies spare part types and replacement frequencies, etc. When the system is operationally deployed, reliability and maintainability field data is used to support logistic resources reprovisioning efforts.
6.	Human Factors Engineering (Refer to Fig. VIII-1, Block 7)	The human factors effort is directed toward assuring that the system is designed to reflect a proper balance between man-functions and machine-functions (both operational and maintenance functions are considered). ILS facilitates definition of support criteria covering personnel, facilities, support and test equipment, maintenance environment, etc. This criteria is converted into human engineering design inputs (personnel types and skills,

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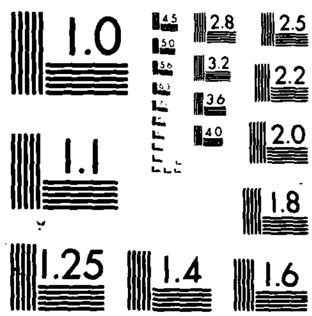

MICROCOPY RESOLUTION TEST CHART
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FIGURE VIII-2 (Cont'd)

6. Human Factors Engineering (Refer to Fig. VIII-1, Block 7) (Cont'd)	environmental requirements) to the system analysis and design process. Given a particular design configuration, human factors analyses (operational sequence diagrams, detailed task analyses) are used in the preparation of technical manual instructions and related data. Also, these analyses are employed in determining personnel training/training equipment requirements, and in facilities planning.
7. Safety Engineering (Refer to Fig. VIII-1, Block 8)	Safety engineering covers both personnel safety and equipment safety. The outputs of safety engineering (hazard analyses) are a necessary input in the preparation of technical manual procedures (through coverage of special tasks, inclusion of warning notices, etc.) and the determination of training/training equipment requirements. In addition, safety requirements may (through reliability and maintainability analyses) impact support equipment and spare repair part requirements.
8. Standardization (Refer to Fig. VIII-1, Block 9)	Standardization is a design-related function responsible to ensure that equipment design incorporates standardized (common) assemblies, modules, and components to the maximum extent feasible, considering cost/effectiveness impact. Standardization considers commonality between weapon systems, commonality among assemblies and components. The results tend to reduce spare/repair part reqnirements, reduce personnel and training requirements, simplify maintenance instructions, and improve reliability and maintainability. ILS activities provide maintenance concept information and employ standardization data in the support engineering analysis process.

FIGURE VIII-2 (Cont'd)

9. Value Engineering (Refer to Fig. VIII-1, Block 10)	Value engineering includes cost targeting and measuring, value analyses, the generation of value engineering change proposals, etc. These activities must consider the initial support criteria (maintenance concept, environment, etc.) provided by ILS. In addition, the resulting value engineering analyses and change proposals must consider total life cycle costs covering all aspects of logistics, and not just design and production costs. In considering such, ILS activities provide logistic support analysis data input to value engineering.
10. Quality Assurance (Refer to Fig. VIII-1, Block 11)	Quality functions are directed toward assuring that designed-in performance, reliability and maintainability characteristics are realized through the equipment acquisition and production process. Quality control and inspection procedures are applied to ILS relative to: the purchase of off-the-shelf items; the production of support and test equipment, spares, and training equipment; and the review of technical manuals (operating and maintenance instructions). This ensures the integrity of logistics resources delivered to the user in the field.

*Coverage herein is limited to major areas of ILS interface common to most programs. Certain interfaces may be emphasized or de-emphasized depending on the nature of the program. In addition, other areas, not included herein, may become equally as important. The extent and nature of the interface between ILS and the related discipline areas is dictated through the appropriate application of government/industry specifications in contracting for a given system.

CHAPTER IX

ILS TESTING AND DEMONSTRATION

1. Introduction. The purpose of an ILS test and demonstration program is to provide assurance and proof to the government that the support system developed can provide the required support to a system or equipment in its operational environment. The following paragraphs identify the type of considerations for test and demonstration of the support system.

2. Requirements

a. Test Demonstration Classifications

The evaluation of a support system commences with development and extends into the operational phase. This evaluation process includes the accomplishment of various types of tests and demonstrations. For the purpose of this document, tests and demonstrations are classified as follows:

(1) Type 1 - Tests/Demonstrations - Informal breadboard, brassboard, or prototype development model tests conducted by the contractor with customer surveillance on an as required basis. These tests are accomplished throughout equipment design, development, and qualification. Although these tests are not formal demonstrations and do not reflect production equipment in a true operational environment, information pertinent to logistic support characteristics is used to update preliminary Logistic Support Analysis. Some of the testing activities include equipment operational and logistic support actions which

are directly comparable to tasks performed in an operational requirement. Data covering these activities are evaluated in terms of operational, maintenance and support factors (e.g., human factors, MTBM, MTTR, MMH/OH). It is during this initial phase that changes to hardware design/configuration can be readily made to eliminate or reduce the need for performing maintenance or operational actions.

(2) Type 2 - Tests/Demonstrations - Formal tests and demonstrations accomplished during the latter part of the development phase on preproduction prototype equipment which is similar to production equipment but not necessarily fully qualified at this point in time. These tests are generally conducted by the contractor at his facility with customer on-site surveillance. Operational support equipment (or equivalent) and preliminary technical manuals are used for test support. Specific types of tests include: formal maintainability demonstrations (refer to MIL-STD-471 and MIL-STD-473 for demonstration methods and techniques), support equipment compatibility tests, personnel tests and evaluation, and technical manual verification/validation. Test data is analyzed to determine whether the equipment design/configuration can be changed to eliminate maintenance requirements and if the support system will in fact satisfy the maintenance requirements.

(3) Type 3 - Tests/Demonstrations - Formal tests and demonstrations accomplished prior to large scale production commitments on pilot or daily production systems/equipments. These tests are conducted by customer personnel at the customer's test site. Contractor personnel provide certain pre-defined on-site support. Operational support equipment, operational spares, and formal technical manuals are used. Specific testing includes: Navy - Board of Inspection and Survey, Air Force-Category II Test, and Army - Engineering Test and Service Test. Field Test data is collected and analyzed to determine whether the equipment design meets all maintainability and maintenance quantitative requirements. This is the first time that all elements of the system are operated and evaluated as a support system. Here is the first opportunity to assess total system design from a support standpoint as well as assessment of the support system in terms of specific support requirements, shop turnaround times, supply pipeline times, etc.

(4) Type 4 - Tests/Demonstrations - Formal tests/demonstrations of the total operational system and its associated support system conducted in a true field operational and maintenance environment. Customer personnel, operational facilities, operational support equipment, spare/repair parts, technical manuals. Formal field data systems (e.g., Army-TAMMS, Navy-3M, Air Force-AFM66-1) provide the data necessary for support system evaluation and assessment.

b. Application of Test/Demonstration

The extent of formal ILS testing/demonstrations accomplished must be tailored to the:

(1) System/equipment type - specific end item, airplane, missile, ship, electronic, vehicle, etc.

(2) System configuration in terms of new development versus the use of an off-the-shelf capability - new development might introduce high risk which influences testing requirements.

(3) Mission objectives and operational/support requirements of the system in terms of quantitative figures-of-merit such as system effectiveness, operational available (Ao) reliability (MTBF), downtime (MDT), etc. Refer to paragraph 2c. below.

The basic objective is to accomplish only that testing required at discrete points in the system acquisition process to gain confidence that the system or equipment will ultimately meet the mission and associated operational requirements for which it was intended. Too much testing is costly. Too little testing won't provide the confidence needed early in the acquisition cycle to determine whether the system will meet its design requirements. The wrong type of testing is also costly and will not provide worthwhile or meaningful results.

When specifying test and demonstration needs for a given program, it is first necessary to address the above mentioned three areas and determine what results can be achieved at specific points in the acquisition process. Secondly, it must be determined these results can be determined analytically

from predictions, design data, and various elements of support engineering analysis. That information which is not available to achieve the desired result must be acquired through physical tests and demonstrations.

System/equipment hardware tests and demonstrations generally can be classified as Type 1, 2, 3, or 4 as indicated in paragraph 2a above. If extensive new development is required, all four types of tests should be used. If the system configuration represents a low risk investment and constitutes mostly off-the-shelf items, then perhaps only Types 3 and 4 tests are necessary. Every system acquisition will require a specific combination of tests and demonstrations involving one or more of the types of tests defined above.

c. Quantitative Figures-of-Merit

The depth and type of tests and demonstrations to be accomplished depend on the system operational and maintenance support requirements. It is assumed that system objectives are initially specified and the equipment is designed to meet those objectives. It is necessary to accomplish tests and demonstrations to ensure that the initially specified objectives have been met or that there is a high degree of confidence that they will be met at some future point. These objectives must be specified in such a manner that they can be predicted and measured.

A quantitative figure -of-merit involves some system measure or a series of measures. For example, minimum operational availability (Ao) where:

$$Ao = \frac{\text{MTBM + ready time}}{\text{(MTBM + ready time) + MDT}}$$ and

Ao: Operational availability or the probability that a system will operate within specified parameters when called upon at any random point in time.

MTBM: Mean-time-between-maintenance is a function of scheduled and unscheduled maintenance requirements.

MDT: Maintenance downtime is a function of active scheduled and unscheduled maintenance downtime, administrative downtime, and logistics downtime.

Ready Time: Time that the system is not operating but is assumed to be in an operationally ready state.

Evaluation of the system in terms of this figure-of-merit can only be accomplished as a Type 4 test since the system is operated as an entity in a realistic operational environment. However, a Type 3 test should provide relatively similar results even though the environment at a test base is not representative of a true operational situation. Also, the system is operated as a separate entity. Type 1 and Type 2 tests/demonstrations are not adequate to evaluate the system in terms of Ao since the system is not integrated and operating as an entity and the logistics support is not available.

Assuming that equipment development is required, it becomes necessary to demonstrate the Ao in terms of some actual measure of design. The elements of Ao (e.g., MTBM and the active

maintenance aspect of MDT) must be broken down and directly related to support characteristics in design. MTBM may be specified in terms of reliability meantime-between failure (MTBF) and the frequency of scheduled maintenance actions. The active maintenance aspect of total maintenance downtime (MDT) may be stated in terms of mean-time-to-repair and mean-time-for preventive maintenance. The design related factors must then be allocated to specific subsystems, equipment items, and assemblies. The hardware items involved are analyzed in terms of technical risk and tests and demonstrations are scheduled accordingly. High risk items where extensive development is involved will require more testing while low risk items will require less testing. For instance, it may be feasible to accomplish both Type 1 and Type 2 tests and demonstrations of MTBM and MTTR on some items, only Type 2 tests of MTBM on some items, and no Type 1 and Type 2 testing for other items. In essence, the extent of testing is determined by the high risk system elements and by the available analytical data covering these elements.

Figures-of-merit are unique to each system. In one instance, operational availability (Ao) may be paramount, while in others, operational availability, reliability (MTBF), maintenance manhours per flight/operating (MMH/FH/OH) and shop turnaround time may be dominant. Specific examples of system maintenance and logistics factors are presented in Appendix A. The extent of test and demonstration will be based on the figures-of merit which represent the desired measures of the system.

3. Test/Demonstration Planning

Test and demonstration planning commences in the conceptual phase. Specific test requirements are considered when the system requirements are initially specified, whether a requirement can be measured or not. Subsequent detailed test and demonstration planning then considers the following:

a. Test conditions (test environment, facilities, test personnel, technical data, spare/repair parts, and support equipment)

b. Test planning, administration, and control (organizational approach, responsibilities, organizational interfaces, test schedules, monitoring of test activities, cost control and reporting)

c. Predemonstration phase (demonstration method, corrective-and-preventive maintenance-task selection, personnel training, preparation of facilities, and acquisition of support requirements)

d. Formal demonstration phase (task simulation type and format of data requirements, collection methods, reduction, and analysis)

e. Retest phase (methods for conducting required additional demonstrations)

f. Test documentation (test-reporting requirements)

The planning information is included in a formal support system test and evaluation report at a specified time prior to commencing with the applicable system test and demonstration.

4. Pre-Demonstration Phase

Encompasses the necessary prerequisites to accomplish a formal test/demonstration. This includes:

a. Selection of a test/demonstration model. The equipment configuration used in the demonstration must be representative of the operational systems to the maximum extent possible. Types 2, 3 and 4 tests are usually conducted on pre-production or production units. Type 1 tests usually are accomplished on breadboard, engineering or service test models. The preparation tasks involve selecting the test model by serial number, defining incorporated versus unincorporated changes, and ensuring that it is available for formal test/demonstration.

b. Support Engineering Analysis. Analysis data serves as the basis for determining the equipment aspects and maintenance functions/tasks to be demonstrated.

c. Test samples. Selection should be based on the variances of the tasks to be represented, on equipment complexity and on the probability of expected error. It is desirable to select a sample size large enough to be representative and small enough to be compatible with total programs-cost and scheduled requirements. A large sample size will provide more definitive test results, but time and cost of testing increase as testing is expanded. A small number of samples may produce inconclusive test results. Refer to MIL-STD-471 and MIL-STD-473 for the procedures used in test sample size selection.

d. Test facility and resources. During preliminary planning, it is necessary to ensure that the test facility and associated resources will adequately support the formal test/ demonstration.

e. Specification test personnel. To the maximum extent possible, selected personnel should possess the grades and skills equivalent to those who will ultimately be operating and maintaining the system. The preparation task includes selection and the training of such personnel to the degree represented by skill levels specified.

f. Identification of formal operational and maintenance technical manuals. Operations and maintenance functions (diagnostic routines, repair actions, servicing requirements, etc.) must be tested/demonstrated in accordance with formal technical manual procedures.

g. Identification of support equipment. The support equipment configuration used must represent a qualified production unit or a close similarity. The preparation task includes the selection of specific support equipment items by serial number, description of the configuration, associated technical manuals, and the delineation of required spare/repair parts. Support equipment and associated resources must be provisioned, checked out and delivered on-site prior to initiation of the test/ demonstrations.

h. Supply Support

Support engineering analysis data will indicate spare/repair

part types and quantities by each echelon or level of maintenance to be demonstrated. The preparation task includes the provisioning of such items for on-site support of test/demonstrations and methods to assess resupply times and techniques.

i. Identification, design and procurement of unique items of test equipment that are not integral to the overall system. It is necessary to refer to the test plan and the technical manuals pertaining to the system being tested to derive these requirements.

5. Test/Demonstration Phase

Formal tests/demonstrations constitute the complete simulation of all previously specified scheduled and unscheduled maintenance functions and tasks. The specification of such tasks stems from the support engineering analysis data. For simulation of unscheduled maintenance tasks, the system is considered to be operating, a malfunction occurs (either through inducement or via catastrophic failures occurring at random points in time), and the necessary detection, diagnostic, remove and replace, repair, and verification tasks, returning the system to an operative state are performed. Each maintenance action is evaluated relative to times, personnel requirements (skills and quantity), technical manual adequacy, support equipment compatibility, spare/repair part needs, and the adequacy of facilities and associated resources. Data recorded during the test is analyzed in terms of compliance

with the initially specified system figures-of-merit and the effectiveness of the prescribed support system. This approach is also followed for scheduled maintenance actions except that individual demonstrated tasks will differ.

Specific test and demonstration methods, selection of sample sizes, accept-reject criteria, reporting, etc., are illustrated in MIL-STD-471 and MIL-STD-473. These standards primarily concentrate on maintainability requirements which are only a part of logistics.

Although requirements are differnt, a typical program phasing of these tests and demonstrations is presented in figure IX-1.

6. Data Analysis and Corrective Action

The data resulting from logistic support testing must be analyzed in such a fashion that the results of the analysis reflect preplanned corrective actions correlated to program contingency planning. This requires that data analysis must be preplanned in an organized, documented, systematic fashion prior to the conduct of testing.

Type 1 test data analysis and corrective actions must be tailored to only those characteristics of systems support that informal breadboard or prototype development model type testing can investigate. This applies to those support considerations predicated on correlated reliability and maintainability design features--things like redundancy concepts, repair-while-operating considerations, built-in test levels,

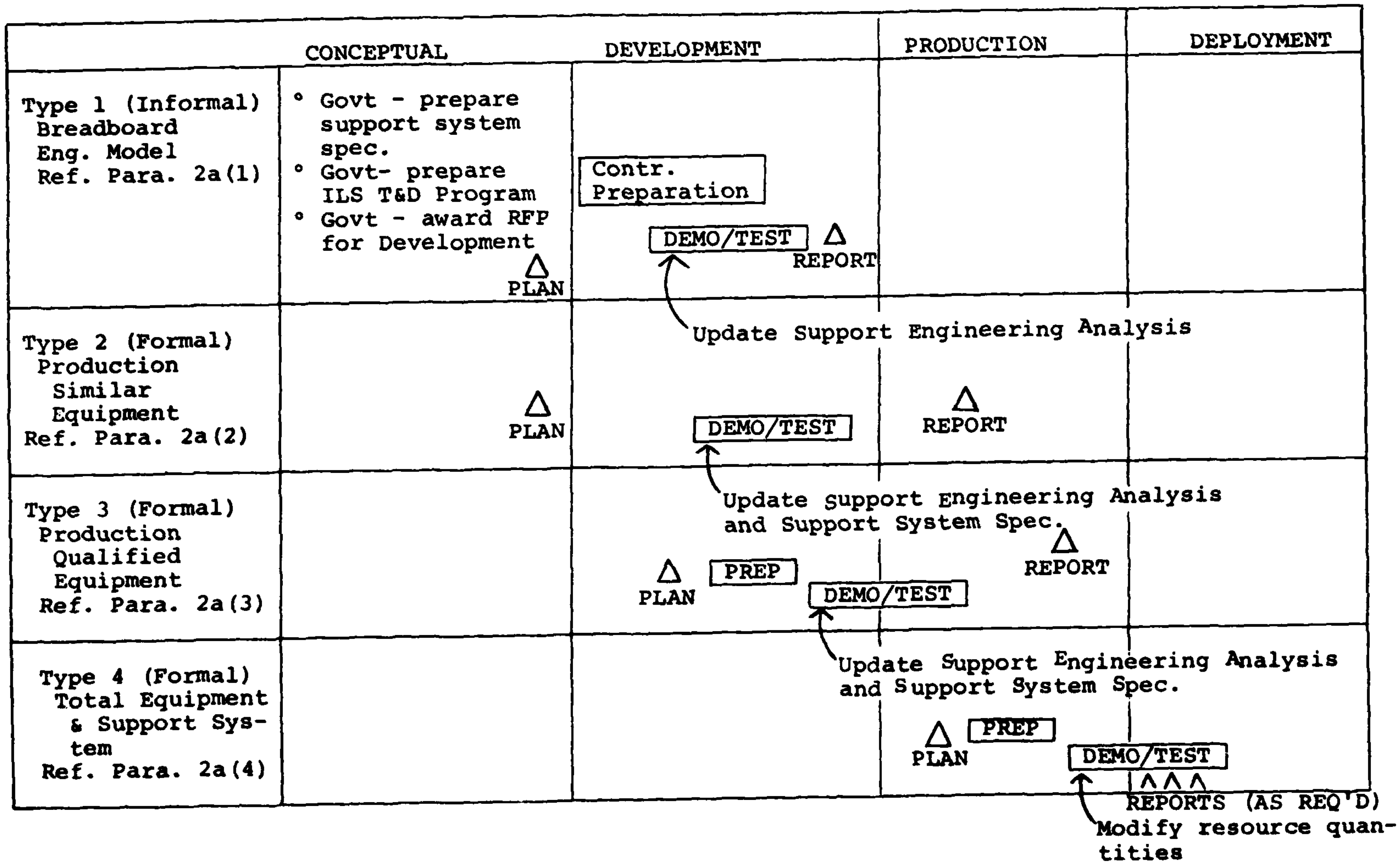
modularity, commonality, etc. The feed-back resulting from this testing is directed towards the support concept.

Type 2 test data analysis and corrective actions are tailored to form, fit and maintenance characteristics of systems that directly effect on-line support considerations. The feedback resulting from analysis of this data is planned to confirm or modify support equipment, technical manuals, personnel requirements and maintenance and supply burdens. It should also give preliminary validation to organizational level support concepts.

Type 3 test data analysis and corrective action loops are tailored to verify the system performance and support in the operational environment. They further substantiate the assumed reliability and maintainability characteristics that the support concept is predicated on and give formal assessments to off-line maintenance requirements as well as preliminary validation and correction. They add to Type 3 testing the provisioning and higher echelon (depot and contractor) support validations.

Except for Type 4 test data analysis and corrective actions, the total support system cannot be truly tested or validated. However, by judicious test planning and design, the characteristics of the system that effect the corrective actions required at each point in the life cycle can be identified. The program manager must specify data requirements and analysis procedures appropriate to those corrective actions while also constantly building up confidence in the overall support concept and its quantitative requirements.

FIGURE IX-1
TESTING AND DEMONSTRATION APPLICATION



CHAPTER X

ILS MANAGEMENT AND ELEMENT PLANNING

A. INTRODUCTION

1. The keystone to effective utilization of the ILS process is the application of a systematic and orderly management process through which the program manager identifies actions and requisite decisions in a timely manner. Accomplishment of this orderly and disciplined approach must include a planned series of positive management activities geared to both the basic elements of ILS and the many related disciplines. ILS has sufficient flexibility to permit the program manager to tailor the detail and complexity of his management effort, however, the process also possesses sufficient emphasis on effective interrelation of all the elements to reduce the chances of costly logistic error through oversight.

Overall management of the ILS effort will require the program manager to establish within his organization methods of communication that will permit changes in one or more of the elements of ILS to have their full effect on other elements and design, Figure X-1, and included in all planning. Closely related to the essential need for communications within the program is the need for the finite identification of responsibilities. This requires identification of who is responsible to act or decide on certain matters and how the consequences of these actions or decisions can be made to impact

on other elements. To deal with this concern, the program manager must structure his ILSP in such a fashion as to clarify responsibilities and facilitate program interactions.

2. The mainstream of the short discussion on planning of ILS elements provided above can be summarized as follows:

a. ILS planning is effective when the plan clearly and completely identifies WHAT is to be accomplished.

b. In order to ensure the accomplishment of the actions necessary to the program, the planning must identify WHO is to accomplish the actions.

c. Once the required actions and responsibilities are identified, planning must clearly establish WHEN the actions are to occur in terms of scheduling that is meaningful to the program.

d. All of the managerial aspects of the ILS effort must be the subject of a system of organized passage of INFORMATION. Without INFORMATION, the program manager cannot manage the WHO, WHAT, and WHEN aspects of his program and cannot integrate his logistic support elements.

In the matrix which follows, Figure X-2, a number of events and actions have been identified as pertaining to specific elements of ILS in a time phased array in the development cycle. Additionally, the interface of the elements with overall support management, maintainability and reliability and design management is reflected. See DOD Integrated Logistic Support Planning Guide (4100.35-G) for additional information.

This matrix is provided only as illustrative example of things the program manager must consider during development of his system/equipment. Paramount in any examination of the matrix is the fact that throughout the entire cycle the interrelationship of all the elements continues, thus providing the desired overall integration.

The reader can also coordinate the event identifiers, i.e., F-2; MP-13, etc, with appropriate identifiers in the element event narratives (of this chapter) which address specific actions.

B. SYSTEM SUPPORT ENGINEERING

During Program Initiation, most of the ILS element actions are similar in nature. Also, specific program parameters have not yet been defined. As shown in the ILS Planning matrix, these actions have been consolidated into System Support Engineering (SSE) events. Detailed procedures are addressed in Chapters II through IX.

PROGRAM INITIATION
SYSTEMS SUPPORT ENGINEERING EVENTS

[1] (SSE-2) ANALYZE SUPPORT REQUIREMENTS AND CAPABILITIES

The current/projected requirements and capabilities to support the proposed system/equipment are analyzed and alternatives identified. Supporting rationale is proposed.

(SSE-3) PERFORM SUPPORT CONCEPT TRADE-OFF STUDIES

The feasibility of each trade-off is evaluated based on such factors as operational requirements, maintenance concepts, transportation modes, facilities, etc. Technical problems, cost information, and high risk areas are identified. Results

[1] The Steps SSE-2 through SSE-9 apply to all element areas but are outlined only once to avoid repetition.

must be compatible with total system/equipment objectives.

(SSE-4) ESTABLISH BASELINE SUPPORT CONCEPTS

Support concepts are formulated by considering maintainability and reliability, maintenance planning, material management, life cycle costs, etc. Prepare concept selection rationale and identify funding needs.

(SSE-5) PREPARE SUPPORT DEVELOPMENT PLAN REQUIREMENTS

Concepts are translated into requirements to be integrated into the overall system/equipment support plan package. Specific portions of the plan include maintainability and reliability, maintenance, supply, facilities, personnel and training, funding, tech data, and transportation.

(SSE-7) ESTABLISH SUPPORT EVALUATION CRITERIA

Criteria include policies for determining how well each proposal meets readiness performance specifications and cost requirements, takes advantage of current resources, minimizes technological risks, and considers life cycle costs for support.

(SSE-8) PERFORM SUPPORT SYSTEM EVALUATION

Performance, schedules, cost, and high risk areas are evaluated. Best features from various proposals are incorporated into the final support plan.

(SSE-9) DEFINE SYSTEM SUPPORT DESIGN CRITERIA FOR SUPPORTABILITY

An integrated package of time-phased support element plans and criteria forms the support development plan.

(SSE-10) DEVELOP DETAIL DESIGN REQUIREMENTS FOR SUPPORTABILITY (CONTINUOUS) AND DEVELOP DETAIL SUPPORT SYSTEM REQUIREMENTS

Concurrent with the development design effort, logistics support requirements for all ILS elements are generated by detailed logistic support analyses of equipment designs. Designs are reviewed and approved to assure that established logistics support requirements can be satisfied.

C. THE MAINTENANCE PLAN

Integration of the maintenance plan with the other ILS elements permits effective evaluation of projected requirements and translates them into both design criteria and alternative support concepts. The maintenance plan responds first to operational requirements and secondarily to economies in the commitment of support resources. Early in program initiation, the program manager must identify candiate concepts and philosophies of maintenance that may apply to the item under development. Clarification of these concepts and philosophies is accomplished as the program is continued and precise details on maintenance actions and capabilities are determined through the application of analyses and trade-off studies. As with all elements of ILS, the maintenance plan develops concurrently with the hardware design, and is updated to reflect design modification and change. It is essential that the ILSP provide the program manager with information that affects the maintenance plan development and eliminates unproductive methods of maintenance. As the item under development nears the operational phase, a portion of the testing and evaluation of the ILS effort must be devoted to providing that the maintenance plan will

properly support the system/equipment in the intended operational environment.

MAINTENANCE PLAN EVENTS
FULL SCALE DEVELOPMENT

*(MP-10) CONDUCT MAINTENANCE ENGINEERING ANALYSIS

(a) Perform maintenance engineering analysis to identify support action frequency, location, elapsed time, and also refined requirements for the remaining ILS elements with the exception of funds and data.

(b) Perform trade-offs to design, operating, or maintenance concepts where maintenance engineering analysis indicates

(MP 13 & 14) EVALUATE MAINTENANCE DEMONSTRATION OF PROTOTYPES

Assure performance of a maintenance support demonstration in accordance with the maintenance plan and its evaluation against the effectiveness criteria contained in the specifications and contract. The demonstration must verify selected maintenance requirements and other element requirements.

(MP 17) UPDATE MAINTENANCE PLAN

(a) Correct deficiencies and perform maintenance plan update at critical point of design release to establish firm product baseline.

(b) Analyze all design change recommendations to determine impact on the maintenance system and bring changes which impact cost effectiveness to attention of program director.

(MP-18) CONDUCT MAINTENANCE SUPPORT DEMONSTRATION AND EVALUATION

(a) Assure a maintenance support demonstration is

*See SSE 2 through 9.

conducted and determine the degree to which the maintenance plan, system specifications, and contract objectives have been met.

(b) The maintenance support demonstration should prove that system design for maintainability has been accomplished as per contract and the maintenance plan encompassing other element concepts will provide valid system support (see Chapter IX).

PRODUCTION

(MP-19) PRESENT MAINTENANCE PLAN TO USER

Update maintenance plan in the ILSP; user is then presented with full briefings and explanations of system and its peculiarities.

D. SUPPORT AND TEST EQUIPMENT

It is the aim of the ILS management of this element to ensure that the operating forces are provided with all the essential items required to perform both scheduled and unscheduled maintenance actions. Information on support and test equipment trade-offs must be made available to the program manager to permit him to make decisions on special purpose equipment, built in testing, automatic testing, use of inventory test equipment, and similar considerations.

SUPPORT AND TEST EQUIPMENT EVENTS
FULL SCALE DEVELOPMENT

*(SE-10) UPDATE SUPPORT EQUIPMENT REQUIREMENTS

Assure that measurement standards plus any new requirements are completely validated, and the plan is updated.

*See SSE 2 through 9.

(SE-11) DESIGN SUPPORT EQUIPMENT

(a) Assure initiation of peculiar and supporting measurement standards design.

(b) Acquire GFE in inventory.

(c) Identify peculiar and GFE calibration requirements and determine availability.

(d) Initiate action to develop and acquire organizational, field, and depot requirements to effect adequate calibration support.

(SE-13) VERIFY AVAILABILITY OF SUPPORT EQUIPMENT

(a) Verify equipment support requirements indicated by the prototype demonstrations.

(b) Assure that equipment is available for system and subsystem demonstrations and update the plan to reflect any changes required.

(SE-16) AWARD SUPPORT EQUIPMENT REQUIREMENTS

Assure that changes resulting from first article review are included, and the plan is updated.

(SE-18) ACCOMPLISH SERVICE TEST OF SUPPORT EQUIPMENT

(a) Assure service test includes demonstrations of:

1. Equipment performing miantenance support functions as prescribed by maintainability goals.

2. Interfaces with entire system without duplications.

3. Item acceptability for the required service use.

4. All performance requirements, including verification of applicable technical data.

(SE-19) VERIFY AVAILABILITY OF SUPPORT EQUIPMENT

(a) Verify availability prior to operational suitability tests,

(b) Assuring that tests are performed using equipment in the proper configuration.

(SE-21A) ISSUE SUPPORT EQUIPMENT

Deliver equipment to first operating unit after completing necessary interface actions between contractor, storage locations and receiving unit.

SE-21B) VALIDATE/UPDATE SUPPORT EQUIPMENT REQUIREMENTS

Discrepancies found during delivery acceptance, installation and/or preliminary operations are submitted as changes for updating the support equipment plan and specification.

E. SUPPLY SUPPORT

Information developed from analysis of projected supply levels, replacement rates, storage sites, etc. are provided to the program manager for inclusion in decisions relating to other elements. During program initiation the program manager interrelates the concepts expressed in the maintenance plan with various alternative methods of providing the necessary material support. As development continues, he employs the data provided him to make specific decisions that will result in responsive supply support. In addition to the major factors of supply support, such as provisioning and stockage levels, the program manager must ensure that secondary effects, ranging from changes in fuel requirements and facility usage to simple

matters in housekeeping backup, are identified as part of the overall logistic effect of the new system/equipment.

SUPPLY SUPPORT EVENTS
FULL SCALE DEVELOPMENT

*(SS10) PREPARE PROVISIONING DOCUMENTS FOR TEST

(a) Develop incremental provisioning documentation concurrently with start of detailed design and maintenance engineering analysis, including: spares, repair parts, lubricants, epoxies, gasses, fuels, etc.

(b) Assure contractors' recommendations are received incrementally and include:

1. Range of items established by maintenance engineering analysis

2. Location and quantity

3. Explanation of ground rules and methods of calculation.

(c) Assure contractor recommendations are compatible with operational provisioning and cover all requirements for test and training activities prior to equipping the first operational organization.

(SS-11) APPROVE ITEMS PROVISIONED FOR TEST

(a) Review, adjust and/or approve contractors'provisioning recommendations based upon past experience with similar systems.

(b) Assure progressive development of distribution programming and delivery schedules in accordance with program requirements and milestones.

*See SSE 2 through 9.

(SS-12 A and B) PROCURE SPARES, REPAIR PARTS AND SPECIAL SUPPLIES FOR TESTING AND TRAINING

Inititate procurement for items recommended in the approved test and training provisioning documentation.

(SS-16) PROCURE SPARES, REPAIR PARTS AND SPECIAL SUPPLIES TO SUPPORT OPERATIONS

Procure or produce items for issue to service test and initial operating units, based upon test and training provisioning data.

(SS-18) VERIFY SUITABILITY OF SPARES AND REPAIR PARTS

(a) Verify suitability of all spares and repair parts giving special consideration to items critical to operational readiness with regard to:

1. Selection validity based upon maintenance requirements.

2. Supply system effectiveness regarding item location and delivery time.

3. Item acceptability regarding packaging, storage and other

4. Other specified performance requirements.

PRODUCTION

(SS-19) DELIVER SPARES AND REPAIR PARTS TO USER

Assure using organizations requisition spares, repair parts, and special supplies in time to satisfy operational needs

(SS-21) VALIDATE/UPDATE PROVISIONING PLAN

(a) Assure provisioning plan is updated to reflect changes resulting from test finding.

(b) Assure changes are coordinated and processed for inclusion in the ILSP.

F. TRANSPORTATION AND HANDLING

Transportation and handling considerations include identification of the actions and requirements necessary to ensure the capability to transport, preserve, package, and handle the developing system/equipment and all of its associated and related support material. The effect of careful consideration of this element in the ILSP will be evidenced in the development of material that makes maximum use of methods that impose minimum additional transportation and handling burdens on the user.

TRANSPORTATION AND HANDLING EVENTS FULL SCALE DEVELOPMENT

*(TH-10A) UPDATE TRANSPORTATION AND HANDLING REQUREMENTS

Assure transportation and handling requirements, including design support characteristics, are continuously updated through all significant events leading to an established product baseline.

(TH-10B) INPUT TRANSPORTATION AND HANDLING SPECIFICATIONS TO SYSTEM SUPPORT PLANS

Assure development of detailed design specifications from updated requirements.

(TH-16) AWARD SPECIAL TRANSPORTATION AND HANDLING CONTRACTS AND AGREEMENTS

(a) Assure requirements, concepts, and equipment specifications are complete prior to release of contracts

*See SSE 2 through 9.

(b) Initiate host/tenant agreements necessary for follow-on support.

(TH-16) EVALUATE TRANSPORTATION AND HANDLING OF HARDWARE

(a) Assure demonstrations evaluate and verify the following:

1. Equipment and packaging capabilities achieve all operational support objectives.

2. Adequacy of host/tenant and interdepartment agreements.

3. Contract change inputs identified.

4. Active support for the required testing.

PRODUCTION

(TH-21) UPDATE TRANSPORTATION AND HANDLING REQUIREMENTS

(a) Update to assure:

1. Availability of guidance for operational support activities.

2. Identification of potentially critical problem areas regarding specialized equipment, modes, routing, etc.

3. Identification of all equipment and facilities required for receiving, on-site handling, storage and reshipment of system and support resources.

4. Identification of special instructions and controls for all items requiring reuse of packaging at production site.

G. <u>TECHNICAL DATA</u>

The ILSP must contain provisions to insure that timely and appropriate data calls are made and provided for decision making purposes.

TECHNCIAL DATA EVENTS
FULL SCALE DEVELOPMENT

*(TD-10) BEGIN PREPARATION OF PRELIMINARY TECHNICAL DATA

(a) Assure preliminary tech data will support engineering tests and demonstrations.

(b) Areas to be analyzed are: orientation information, operations, schedules maintenance and structural repair, illustrated parts breakdown, inspection and test requirements and procedures, checkout and fault isolation, transportation, handling, and installation, remove and replace, and shutdown.

(c) Assure establishment of a system to accommodate design and support changes on a timely basis.

(TD-14) VERIFY SUITABILITY OF PRELIMINARY TECHNICAL DATA

(a) Verify that data type, format, and application satisfy support requirements and program goals.

(b) Assure demonstration of compatibility between tech data and equipment configuration and operation.

(TD-16) PROCURE FORMAL TECHNICAL DATA

(a) Initiate procurement upon approval and award of support resources contracts.

(b) Assure tech data are released to: (1) support provisioning and procurement of initial support requirements,

(TD-18) VERIFY SUITABILITY OF TECHNICAL DATA

(a) Tech data and the tech data plan are updated as a result of deficiencies found during physical configuration audit.

*See SSE 2 through 9.

(b) Assure tech data demonstrations during user service testing accomplish the following:

1. Verify adequacy of tech data to support operations and maintenance and all activities required to achieve program goals.

2. Verify utility, accuracy, and completeness

3. Verify applicability to the intended personnel skill levels.

4. Verify ease of access and timely updating capability.

PRODUCTION

(TD-19) DISTRIBUTE TECHNICAL DATA TO USER

(a) Assure tech data distribution schedules are compatible with test, installations, checkout and turn-over

(b) Conduct preliminary user acceptance review.

(TD-21) VERIFY/UPDATE TECHNICAL DATA PLAN

Based upon results of user service tests, update tech data plan for follow-on procurement after thorough coordination and for inclusion in the support management plan.

H. FACILITIES

Facilities planning must be addressed early in the development of new systems/equipments due to the long-term nature of funding requiring legislative approval. Justification will be based on operational and maintenance analyses, equipment design drawings, specifications, and other documentation.

FACILITIES EVENTS
FULL SCALE DEVELOPMENT

*(FA-10) BEGIN FACILITY CONSTRUCTION (PROTOTYPE)

Begin prototype facility construction maintaining an awareness of all design and support changes that could impact facilities.

(FA-11) VERIFY AVAILABILITY OF PROTOTYPE TEST FACILITY

(a) Analyze prototype test facility for compatibility with requirements prior to system and subsystem domonstrations.

(b) Evaluate facilities to determine impact of change requirements made known during installation, checkout and test of prototype.

(FA-12) OBTAIN APPROVAL FOR MILITARY CONSTRUCTION

(a) Update facilities requirements specifications, plans and drawings, and obtain approval for military construction of operational and support facilities.

(FA-16) COMPLETE FINAL DESIGN AND AWARD FACILITY CONSTRUCTION CONTRACTS

(a) Advertise for bid concurrent with the initiation of equipment production.

(b) Evaluate bids and award contracts.

(c) Verify final design and installation for other than military construction facilities.

(FA-17) Complete Facility Construction

Progressively accomplish inspection and acceptance of facility throughout system and equipment installation, checkout and service test.

*See SSE 2 through 9.

(FA-18) ACTIVATE OPERATIONAL SUPPORT FACILITIES

(a) Activate operational and support facilities for service test.

(b) Test and verify facilities design and equipment interfaces during equipment and support demonstrations.

(c) Identify and correct deficiences by trade offs between operation and support, equipment and concepts.

PRODUCTION

(FA-21) VALIDATE/UPDATE FACILITIES PLAN

(a) Update facilities plan to provide: guidance for follow-on activities, identification of critical problem areas, special transportability and operational criteria, and an awareness of special requirements for survivability, security, etc.

I. PERSONNEL AND TRAINING

To manage this element requires establishment of a well-defined series of schedules that include derivation of new training programs, assignment of students, transfer of graduates and manning of new units. This element is extremely sensitive to schedule fluctuations in other elements. This sensitivity is the result of the perishable nature of trained personnel assets, which will rapidly dissipate if not effectively employed at the scheduled time. The life-cycle cost of this aspect of logistic support has the potential to exceed the costs of all other elements combined, therefore, it requires the application of careful and attentive managerial attention.

PERSONNEL AND TRAINING EVENTS
FULL SCALE DEVELOPMENT

*(PT-11A) DETERMINE PERSONNEL AVAILABILITY (CONTINUOUS)

(a) Review personnel requirements and compare to availability of personnel skills and quantities.

(b) Analyze changes in skill and quantity requirement for impact on recruiting and training programs.

(PT-11B) PREPARE TRAINING PACKAGE

Prepare a training package to accomplish the following:

1. Identify operation and maintenance personnel tasks.
2. Correlate tasks to skill speciality classifications.
3. Establish learning levels and performance standards.
4. Define cross training requirements
5. Identify training courses, aids, and equipment.
6. Plan to select and train instructors.
7. Identify program demonstrating training, effectiveness.
8. Define plan, updating procedures to reflect tests and operations experience.
9. Plan for transition of training responsibility from developing to using agency.

(PT-12) BEGIN INSTRUCTOR TRAINING

Initiate training of personnel, on prototype or simulators, to support installation, assembly, test, and operation.

(PT-13) BEGIN OPERATIONS AND MAINTENANCE PERSONNEL TRAINING (CONTINUOUS)

(a) Initiate training of required military personnel to support tests and operations.

*See SSE 2 through 9.

(b) Assure sufficient lead time to train personnel in quantity and skill level to meet specified readiness goals.

(PT-17) UPDATE PERSONNEL AND TRAINING REQUIREMENTS

Identify deficiencies, effect optimum trade-offs, and document by revision to personnel lists and training packages.

(PT-18) VERIFY REQUIRED SKILL LEVELS

Through system demonstrations, update and correct performance standards on:

1. Appropriateness of skill level to task.
2. Time required to perform task.
3. Adequacy of support equipment
4. Adequacy of other support elements.

PRODUCTION

(PT-19) VERIFY AVAILABILITY OF TRAINED PERSONNEL FOR OPERATIONS AND MAINTENANCE

Confirm availability of trained personnel in required quantities and skills for operating units.

(PT-21) UPDATE PERSONNEL AND TRAINING PLAN

Assure adequacy of personnel through service tests and demonstrations and update plans as required.

J. LOGISTIC SUPPORT RESORUCE FUNDS

The program manager must identify cost factors by type, and by year required in his developmental schedule. To accomplish this requires separation of research dollars from procurement dollars, the examination of military construction dollar costs, and the proper identification of the costs of management of the overall program. All of these dollars must

be justified against budgetary requirements, and the program manager must obtain sufficient information in order to effectively support the program needs against cutbacks in financing. Additionally, a portion of the ILS management of this element must include the use of various methodologies to acquire well grounded estimates on long-range costs of the program in terms of personnel financing and in terms of operational maintenance support.

LOGISTICS SUPPORT RESOURCE FUNDS EVENTS
PROGRAM INITIATION

(F2) PREPARE FUNDING PORTION OF LOGISTICS SUPPORT ESTIMATE

(a) Develop preliminary funding estimates considering: support trade-off studies, exploration of state-of-the-art support equipment and software, and support requirements.

(b) Prepare preliminary life cycle support cost estimates broken down by: Logistics element, program phases, new requirements, and allocation and maintenance of existing capabilities.

(c) Allocate funds for those logistics considerations that will have a major impact on system design.

(F-4) PROVIDE FINANCIAL ESTIMATES

(a) Prepare financial input to the Program Change Request (PCR).

(b) Assure the financial input to the PCR covers funding and manpower for the current and next four fiscal years.

(F-5) DEVELOP FUNDING SCHEDULE REQUIREMENTS

(a) Develop an estimate of each logistics elements budget requirements and identify the financing method for the phases of the program.

(b) Prepare definitive estimates of funding requirements for program initiation, structured by work breakdown line item costs for each logistics element.

(F-7) PREPARE FINANCIAL PLAN FOR SUPPORT

(a) Based upon allocated funds, develop a funding plan which provides a complete breakdown to the task level.

(b) Identify and differentiate between tasks to be performed organically and those to be performed by contractors.

(F-8A) UPDATE FINANCIAL PLAN FOR SUPPORT

(a) Include all new or revised requirements.

(b) Establish procedures which provide for continuous review of manpower and financial requirements and routine update and refinement of the "Five Year Defense Plan."

(F-8B) CONFIRM AVAILABILITY OF FUNDS

(a) Compare the financial plan to actual fund authorizations and identify deficiencies or overages.

(b) Plan versus actuals are analyzed and program risk and impact evaluated.

(c) Decision rendered as to accepting risks and minimizing program impact; results are documented in the support development plan for final approval to enter full scale development.

(F-9) ALLOCATE FUNDS FOR DEVELOPMENT PHASE

Assure allocation of funds to government and contractors for full scale development.

FULL SCALE DEVELOPMENT

(F-10) REVISE PLAN BASED ON DEVELOPMENT CONTRACT

Assure changes in funding requirements are immediately incorporated into the financial plan.

(F-12A) UPDATE PLAN BASED ON DESIGN REVIEWS

Update financial plan to reflect any changes required by testing and demonstrations.

(F-12B) CONFIRM AVAILABILITY OF FUNDS FOR PRODUCTION

(a) Compare updated funding plan to actual fund authorizations and identify deficiencies.

(b) Analyze deficiencies to determine risk and impact and make decision to release funding for production.

(F-14) ALLOCATE FUNDS FOR INITIAL PORDUCTION

(a) Assure test and demonstrations are proceeding satisfactorily and verify identification of all support requirements, then authorize funds for initial production of support resources.

(F-17) ALLOCATE FUNDS FOR FOLLOW-ON PRODUCTION

Assure system specification compatibility with first production article and allocate funds for follow-on production.

(F-18) CONTINUE FISCAL FUNDING CYCLE

Assure continuous monitoring of funding to ascertain each

support element receives and accounts for its share of the funds. Shortages or overages are recorded and funding requests modified accordingly.

PRODUCTION

(F-21) REVISE PLAN BASED ON SERVICE TEST

Update financial plan based upon support changes necessitated by service testing.

K. LOGISTIC SUPPORT MANAGEMENT INFORMATION

Early in any program it is essential that decisions be made on the type of information needed, the quantity necessary on each subject, the form of submission, the means of submission, and the myriad other factors related to obtaining for the program manager the true ability to manage the overall effort. As the ILSP is developed, a very significant portion of the plan must address reporting methods and other forms of information transmission needed by the program manager to develop his decisions.

LOGISTICS SUPPORT MANAGEMENT INFORMATION EVENTS
PROGRAM INITIATION

(MD-2) INPUT READINESS/PERFORMANCE EXPERIENCE

(a) Prepare readiness/performance data based upon history of similar systems/equipment to include: minimum operating hours, on station time, cyclic use rates, turn around time, scheduled and unscheduled maintenance rates, elapsed time per maintenance action, maintenance manhours per operating hour at all levels of maintenance (organizational, intermediate, and depot).

(b) Assure the model utilized considers such variables as reliability forecasts. test results, and planned levels of maintenance and the other logistics elements support concepts.

(MD-3) INPUT USAGE EXPERIENCE INTO SUPPLY MODEL

(a) Prepare model inputs of historical data on similar systems of earlier vintage.

(b) Assure management decisions regarding use of ADPE techniques are based upon evaluations of current and projected capabilities versus program needs and collateral knowledge of the Services and Industry reflecting actual experience.

(MD-4) ESTABLISH PROGRAM DATA REQUIREMENTS

Identify data requirements of all the other support elements.

(MD-5) PREPARE DATA COLLECTION, ANALYSIS AND CONTROL REQUIREMENTS.

(a) Prepare management data requirements to support the PMP which identify the specific contractor and service responsibilities to: collect and report raw data, collate data for analysis and research, disseminate data and reports, evaluate and analyze reported data, report hardware performance and decision justification data for historical purposes.

(b) Assure each data requirement is: throughly justified; the individual responsible for it is identified; included in the logistics support plan; and is required by the RFP.

(MD-7) SPECIFY DATA REQUIREMENTS FOR THE BID PACKAGE

(a) Define specific contractor responsibilities for collection, dissemination, evaluation and use of the required maintenance and support data.

(b) Identify service furnished data available to contractor and applicable communications, proprietary, and security considerations.

(c) Identify other data sources.

(MD-8) EVALUATE DATA COLLECTION AND ANALYSIS PROPOSALS

Evaluate and rate contractors proposals for adequacy, currenty , simplicity and validity.

(MD-9) UPDATE DATA SPECIFICATIONS

(a) Conduct or assist with a contractor/government program manager review to assure clear understanding of individual and interfacing data responsibilities, terms, conditions and definitions.

(b) Consider and discuss a method for future retrieval and feedback of data for use by follow-on systems and programs.

FULL SCALE DEVELOPMENT

(MD-10) UPDATE DATA COLLECTION, ANALYSIS, AND CONTROL PLAN

(a) Update data plans to identify responsibility for data collection, collation, dissemination, storage, retrieval, and the data manager's broad responsibilities.

(MD-11A) DEVELOP STANDARD SYSTEM/EQUIPMENT SUPPORT CODES

(a) Develop and assign codes, when design is definitized, to describe subsystems and components in terms of work unit codes for:

1. Test and demonstrations.
2. Maintenance management and failure data systems.
3. Maintenance engineering analysis control systems.

(MD-11B - 19) PERFORM COLLECTION AND ANALYSIS OF TEST FEEDBACK DATA.

(a) Assure test and demonstration data are fed back to the separate functional support elements for evaluation of the attainment of program goals and objectives.

(b) Assure each change causes an evaluation which defines impacts and trade-off alternatives between design, production and support.

PRODUCTION

(MD-21) UPDATE DATA COLLECTION AND ANALYSIS PLAN

(a) Update data collection and analysis plan based on changes caused by tests and demonstrations.

(b) Clearly define performance reporting methodology for measuring the degree of contract specifications attainment.

(MD-22A) COLLECT AND DISSEMINATE DEMONSTRATION TEST DATA

(a) Compare test results with contract and design performance objectives and report significant deviations of system readiness to program management.

(MD-22A) COLLECT AND DISSEMINATE DEMONSTRATION TEST DATA

(a) Compare test results with contract and design performance objectives and report significant deviations of system readiness to program management.

(b) Assure control documentation reports hardware and support deficiencies and records trade-offs and change proposal justification.

(MD-22B) TRANSITION TO MAINTENANCE MANAGEMENT, FAILURE DATA, AND SUPPLY MANAGEMENT EFFECTIVENESS SYSTEMS

(a) Phase out collection of test data as users begin maintenance management and failure data systems.

(b) Assure user's effectiveness reports identify undesirable trends and deficiencies.

SUPPORT IMPACT ON SYSTEM DESIGN

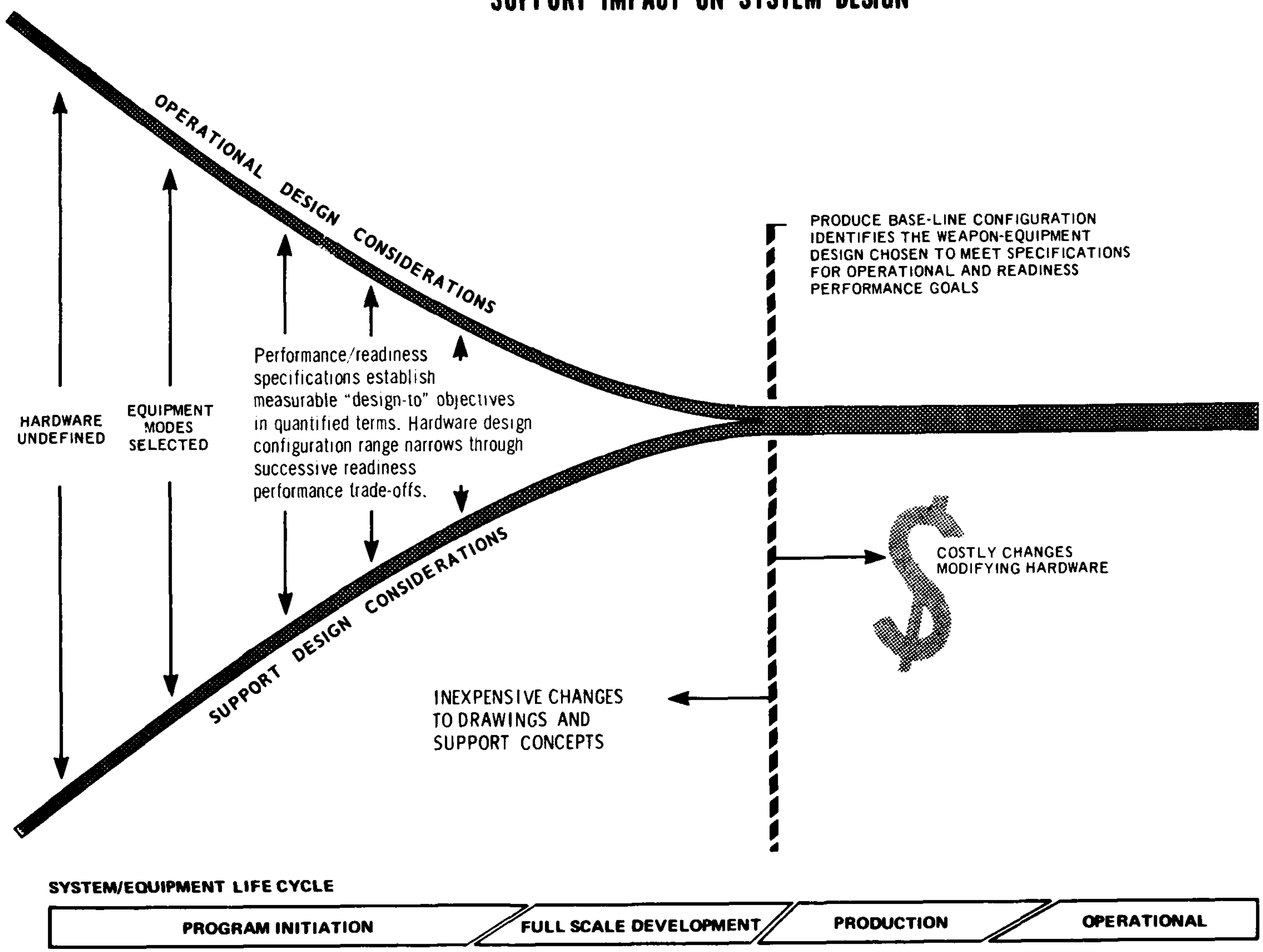
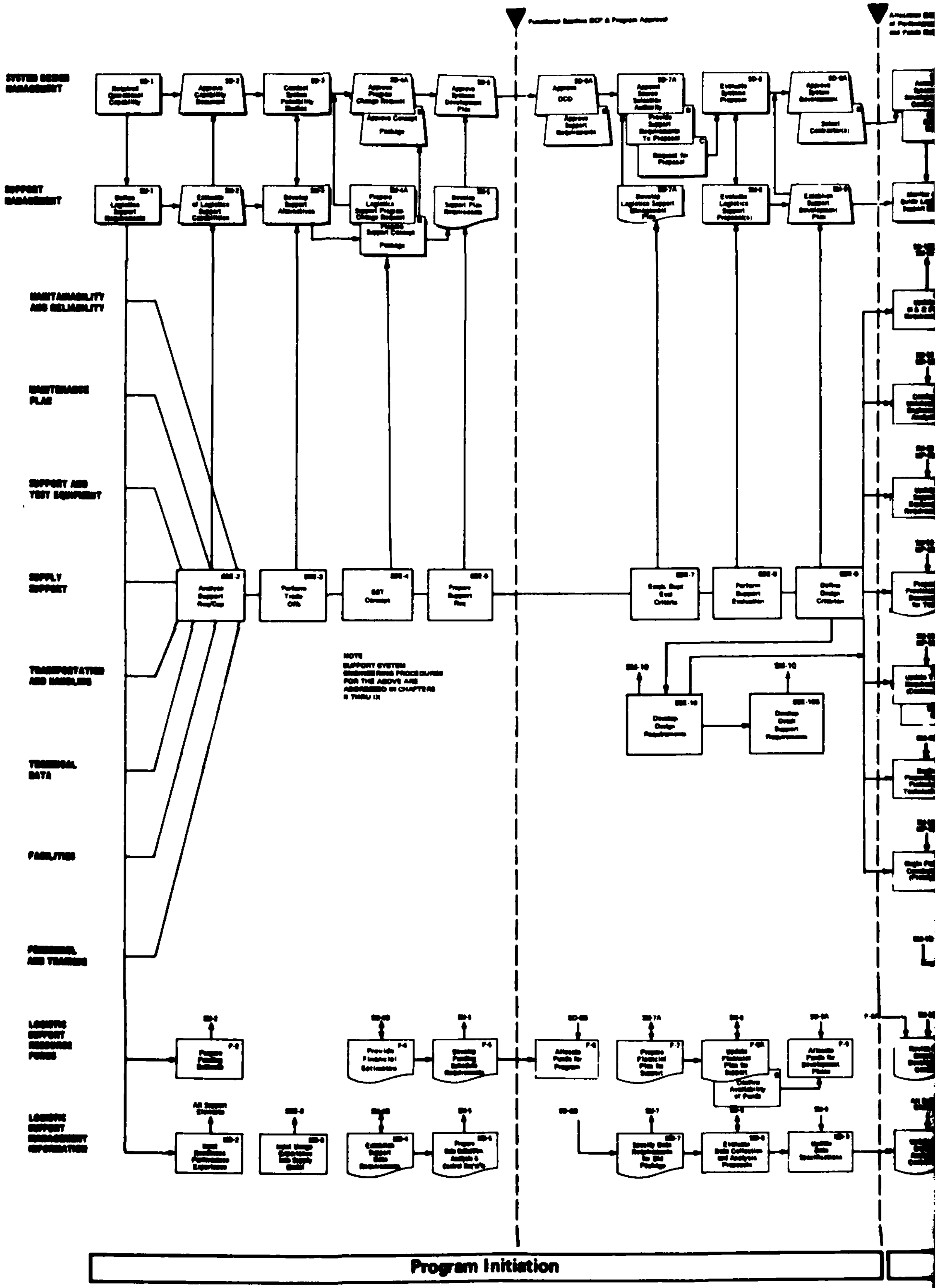
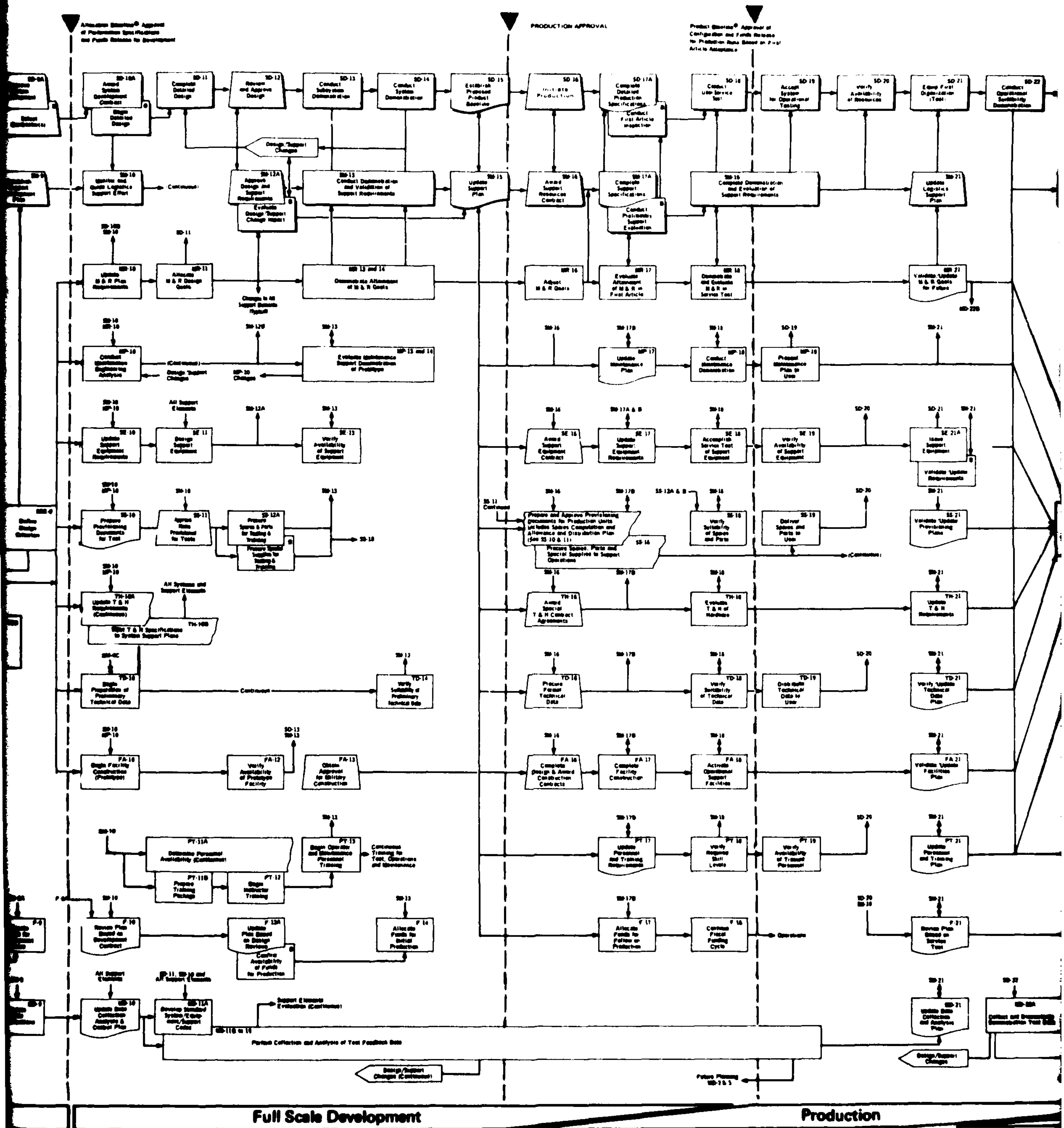


FIGURE X-1


SUPPLY SUPPORT
TECHNICAL DATA
FACILITIES
NOTE
SUPPORT SYSTEM ENGINEERING PROCEDURES FOR THE ABOVE ARE ADDRESSED IN CHAPTERS II THRU IX
Program Initiation



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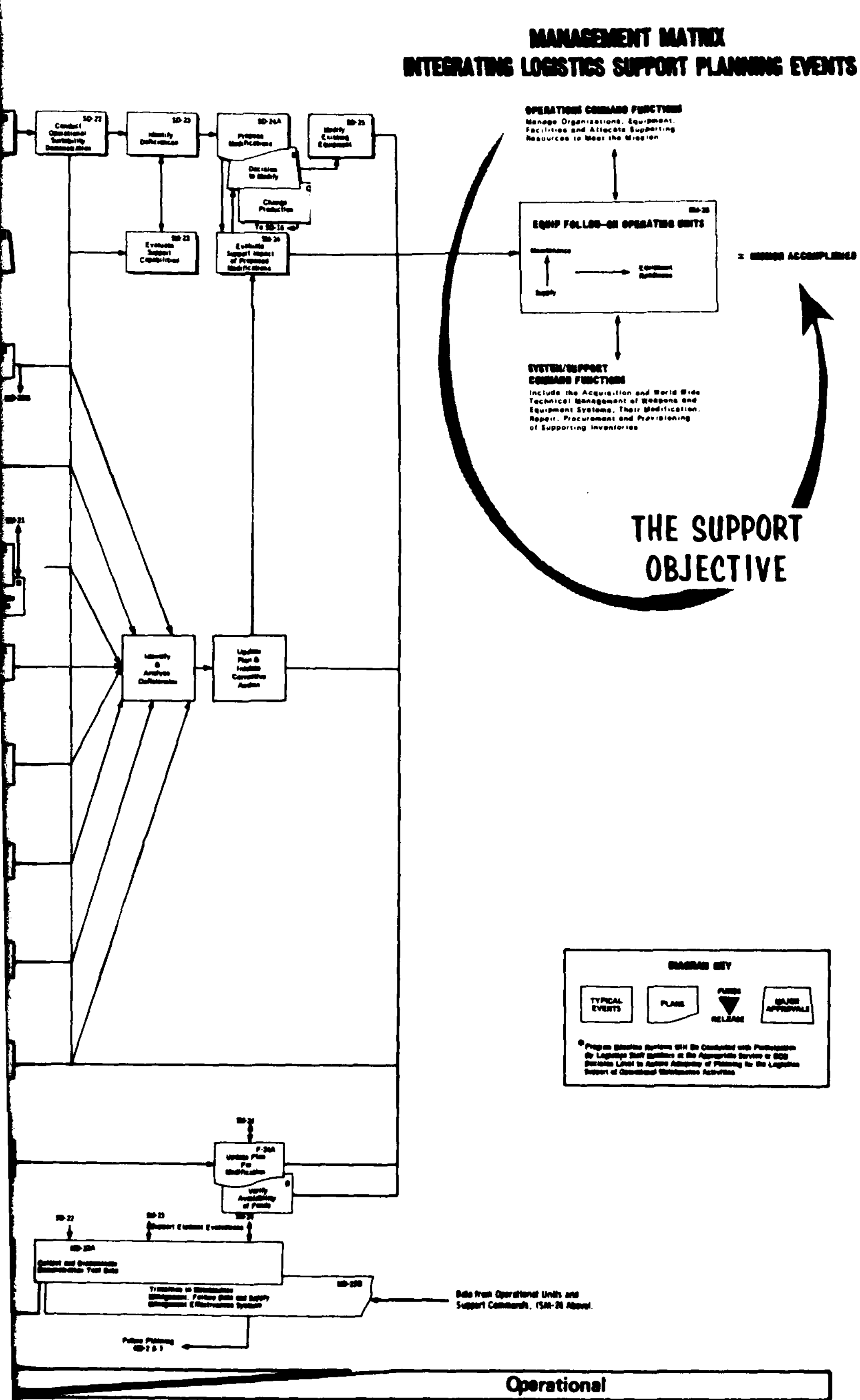
MANAGEMENT MATRIX
INTEGRATING LOGISTICS SUPPORT PLANNING EVENTS
OPERATIONS COMMAND FUNCTIONS
Manage Organizations, Equipment, Facilities and Allocate Supporting Resources to Meet the Mission
SYSTEM/SUPPORT COMMAND FUNCTIONS
Include the Acquisition and World Wide Technical Management of Weapons and Equipment Systems, Their Modification, Repair, Procurement and Provisioning of Supporting Inventories
THE SUPPORT OBJECTIVE
DIAGRAM KEY
TYPICAL EVENTS
PLANS
RELEASE
Data from Operational Units and Support Commands. (SAR-26 Above)
Operational

FIGURE X-2

APPENDIX A

A GUIDE FOR A LOGISTIC SUPPORT SYSTEM SEGMENT SPECIFICATION

THIS GUIDE PRESENTS TWO SAMPLE LOGISTIC SUPPORT SYSTEM SEGMENT SPECIFICATIONS WHICH ILLUSTRATE THE SCOPE OF SUPPORT SYSTEM REQUIREMENTS AND THE DEPTH TO WHICH THEY SHOULD BE SPECIFIED AT TWO DIFFERENT MILESTONES IN THE ACQUISITION PROCESS.

SECTION I

PRIOR TO ENTRY INTO FULL SCALE DEVELOPMENT

SECTION II

PRIOR TO ENTRY INTO PRODUCTION

Purpose of the Logistic Support System Segment Specification

The logistic support system segment specification is proposed as a vehicle which may be used for contractual specification and for baseline control of the support system segment during procurement and evaluation of the support elements. It contains quantitative and qualitative support system requirements and provides the technical basis for interfacing these requirements with the equipment system. The support system is specified to a degree which assures compatibility and coherence among the logistic elements.

The support system segment is specified and correlated in such a manner so as to be compatible with the overall system engineering efforts, particularly in regard to the format and content of specifications for program peculiar items, e.g., MIL-STD-490, which is the preferred source of formats to be used for system specifications.

The narrative portion of this implementation guide is provided for information. The predominant source of direction pertaining to Systems Engineering Management which includes logistic support considerations will be covered in a MIL-STD (499) on this subject when it is issued as a DOD document.

Format of the Sample Specifications

The sample outlines a typical logistic support system segment specification in two formats which illustrate the scope and depth of the contents at two selected milestones in the acquisition process. The support system specification evolves by systematic definition and specification of support system requirements in a manner which is responsive to the policies expressed in DOD Directive 4100.35.

Section I of the logistic support system segment specification reflects the scope and depth required prior to full scale development. It establishes the interface between the support system requirements and the equipment system and includes requirements which govern the inputs from the integrated logistic support function to the design process (reference: DOD Directive 4100.35).

Section II of the logistic support system segment specification reflects the scope and depth required prior to entry into production. It contains all of Section I with some sections treated in more depth and with addition of other sections to complete the specification. The precise point at which Section II will be completed must be designated for each individual acquisition program. Generally, Section II will be completed prior to contractual initiation of the support elements for an established configuration of the equipment system (reference: DOD Directive 4100.35). The sample specification is presented as an outline of the required content. Examples are included in italics to illustrate the scope and depth of each section of the specification. A hypothetical item of equipment, the "XYZ System" was selected to maintain continuity and consistency of the examples.

The sample specification shows the type of information to be presented and is not intended to be all inclusive. The amount of detail will be dependent on (1) the type of procurement and contract content, and (2) the types of specifications (e.g., system, development, and product (prime, critical items, etc.) being prepared and utilized. On a small acquisition, the logistic support system segment specification may be used as the primary logistic support procuring document. On a larger acquisition (particularly one within the scope of DOD Directive 5000.1), some of the sections may be (1) abbreviated summaries with appropriate references, or (2) direct references to existing Section 3 requirements of other specifications or related documents. (For example, by direct reference to performance/physical characteristics or reliability or maintainability or other requirements in specifications being prepared (e.g., to format and contents per MIL-STD-490)). The decision on how to use document and what other documentation is either replaced by or correlated to it is up to the program manager for ILS in collaboration with cognizant systems engineers responsible for the overall specification preparation.

Development of the Logistic Support System Segment Specification

The support system specification is used as the primary source document for the identification of quantitative and qualitative support requirements for an operational item of equipment. It evolves through systematic definition of these requirements in phase with major program events.

Normally, the logistic support system segment specification shall not be prepared during the conceptual effort of program initiation. Logistic support requirements as well as other interfacing requirements (e.g., system definition, reliability, maintainability, operational and organizational concepts, characteristics) should be included in the system specification (e.g., format and contents per MIL-STD-490). Not withstanding, positive correlation will be maintained during the subsequent preparation of the logistic support system segment specification.

Upon entry into full scale development, Section I defines those support system requirements which will have a direct impact on the physical and functional configuration of contract end items of equipment; additionally, it provides the support scenario which is the basis for support analyses and tradeoffs with equipment design. Section I of the support system specification must be completed during the concept phases either by the buyer or by the contractor as a line item of the concept phase contract. Approval by the buyer and by the seller establishes the support system specification Section I as a contract baseline document for full scale development. It is subject to revision by normal specification change action.

The support system specification (example identified as Section II) must be completed during full scale development as the equipment configuration is established. It represents the support system requirements which result from the optimization of the overall system through the disciplines of engineering and the disciplines of integrated logistic support.

Approval by the buyer and by the seller establishes the support system specification Section II as a contract baseline document for the procurement of logistic support elements. It must therefore correspond to an established configuration of equipment and must be completed prior to contractual initiation of support elements.

SECTION I

Outline for A

LOGISTIC SUPPORT SYSTEM SEGMENT SPECIFICATION

1.0 SCOPE

This section should be a summary of what is contained herein together with a descriptive title and objective.

"*Example*":

This specification establishes the support requirements for the XYZ System. Support requirements listed herein refer to quantitative and qualitative criteria to be used to develop the following elements of support:

1. *Support and Test Equipment*
2. *Technical Publications*
3. *Personnel and Training*
4. *Facilities*
5. *Spare and Repair Parts*
6. *Transportation, Packaging, and Handling*
7. *Data File (Collection, Reporting and Analysis)*

1.1 PURPOSE

This Support System Specification was prepared as a control document to provide a central source for the specification of logistic support requirements. It is to be used as the technical baseline document for the development and implementation of Integrated Logistics Support.

This specification establishes the requirements for the support system services, products, and equipment necessary to support the XYZ System during its projected life cycle.

1.2 USE

The preparation and delivery of each of the discrete elements of support identified herein shall be responsive to the requirements of this document for detailed planning and implementation. Changes shall be coordinated through the ILS program manager.

2.0 Applicable Documents

Itemize those documents and specifications which affect the establishment of support system requirements. This includes such documents as:

a. System Specification

b. Component End Item Specification

c. Design Specifications

d. Operational and Maintenance Environment Documents

e. Maintainability and Reliability Requirements/Criteria

Example:

MIL-E-17555	*Electronic and electrical equipment accessories, and repair parts: Packaging and packing of*
MIL-P-116	*Preservation, Methods of*
MIL-Q-9858	*Quality Program Requirements*
MIL-HDBK-472	*Maintainability Predictions*
MIL-STD-471	*Maintainability Demonstration*
SS12345B	*System Specification - XYZ System*
S.O.R. No. 26D	*System Operational Requirements for the XYZ System*
543211F	*General Arrangement - XYZ System*

Specifications which define the format and content of individual logistic plans or items of support should not be included.

3.0 Requirements. NOTE: Referencing is the approved method for including requirements set forth elsewhere (MIL-STD-490).

3.1 System Definition

This section shall identify the system to be supported and define the support system interfaces. It will define the elements of support to be addressed and any unique logistic support capability which must be developed.

3.1.1 System Description

Present a brief physical and functional description of the equipment to be logistically supported. Emphasize the maintenance characteristics of the equipment. Also include pertinent operational parameters maintainability and reliability requirements, system safety requirements and any other system design requirements which must be considered in support planning and in the design of the support system.

Example:

The XYZ System is a short range, high performance infrared seeking device, employing proportional navigation to be used by highly maneuvering fighter aircraft. It is sufficiently flexible to provide launch opportunities early and continuously throughout an engagement with a high probability of kill given a launch opportunity. It is optimized for use with several aircraft.

The device weighs approximately 186 pounds; is 7.0 inches diameter; 95 inches long and consists of three (3) removable major sections:

1. *Guidance Section*
2. *Main Section*
3. *Aft Section*

The following paragraphs present section descriptions and considerations for establishing support system requirements.

3.1.1.1 Guidance Section

The guidance section will contain the IR Seeking device, a cooling device for the seeker, and the electronics necessary for target acquisition, tracking, terminal aim analysis and flight control. This section will not exceed 22 inch length, 7 inch diameter and 24 pounds. It will be capable of being separated from the XYZ System.

3.1.1.2 Main Section

The main section will contain the warhead, the SA8F, the propulsion device, the XYZ System power source, the main electrical harness and the wings. This section will not exceed 58 inches in length, 26 inches in diameter (including wing span) and 140 pounds. This section design will allow separate removal of the warhead and propulsive device to facilitate transport of explosives.

3.1.1.3 Aft Section

The aft section will contain the flight control hydraulic servo system and the proximity fuze. This section will not exceed 17 inches in length, 26 inches diameter (including flippers) and 22 pounds. The section design will provide for removal of the "flippers" with standard hand tools.

3.1.1.4 Launcher

Launcher definition is to be determined due to the multiple interface requirements. The following provides a general description of the two (2) ultimately required launching techniques.

3.1.1.4.1 Rail Launch

The rail launcher will weigh approximately 40 pounds and be capable of providing missile installations on both wing and fuselage with single or multiple mounts. It will contain mechanism for umbilical separation, an electronic unit, and hold back restraints. The umbilical plug will retract at launch blast. The launcher will also be capable of ejection from the aircraft.

3.1.1.4.2 Ejection Launch

The ejection launcher will contain an electronic unit, attach points, and dual ejector mechanisms. The driving force of the ejection pistons will be supplied by a "clean" gas generating system designed to minimize post-firing maintenance. It is estimated that ejector launcher (including gas generator) will weigh 85 pounds.

3.1.1.4.3 Reliability

The table presents the allocated reliability criteria, the section weights, and the probability of section failure given that there is a failure. The reliability criteria are "stressed" to the environment but do not include secondary failures or failures induced due to maintenance or handling.

Component	MTBF(1) (Hours)	P_s	P_F	Weight (lbs)
Guidance Section	526	.9943	.718	24
Main Section	12,000	.99975	.144	140
Aft Section	7,143	.99958	.138	23
Total	468	.9936	1.00	187

MTBF = Mean Time Between Failures in Captive Flight (3 hr)

P_s = Probability of success during 3 hr captive flt

P_F = *Probability of component failure given that there is a failure*

(1) = *Includes BIT detected failures*

3.1.2 Operational Deployment

Present, in narrative form, how the equipment is to be used including scenarios for both war and peace. Discuss the use environments at all levels including critical maintenance functions which are fixed and not subject to the decision making process or to tradeoff. Also include expected number of systems deployed, the number of operational and maintenance installations, quantity of systems per installation. The criteria should be sufficient to establish a baseline generator for maintenance requirements.

Example:

The device will be used to obtain and maintain air superiority during wartime and for evaluation/training during peacetime. Two wartime situations were analyzed to obtain data applicable to missile life cycle utilization and subsequent logistic support calculations. The philosophy applied herein is in accordance with the President's "1-1/2 War" strategy designed to meet a major Communist threat in either Europe or Asia and to support our allies against external aggression.

3.1.2.1 *Environment*

3.1.2.1.1 *Forward Location*

The forward location is considered the worst case environment for the XYZ System. It is an austere operation dictated by the fact that all resources must either be airlifted or supplied by sea and is primarily a wartime situation designed for approximately a short duration. Work shop space is crowded, stored equipment may have minimal protection from the elements, and operations are completely exposed to weather conditions. Quantities of Support and Test Equipment are limited to essential requirements due to airlift allocation restrictions and operational space restrictions. Forward location operations are normally restricted to organizational level tasks.

3.1.2.1.2 Established Bases

Peacetime operation was assumed for established CONUS bases and a combination of peacetime and wartime operations assumed for established overseas bases. Evaluation/training operations were assumed to be conducted at training bases. No unique operational or maintenance environmental difficulties are anticipated while operating from established bases. Consequently, operational deployment can be more easily predicted.

Evaluation/training are assumed to be assigned to primary aircraft with secondary aircraft training accomplished with flight simulators.

3.1.2.1.3 Wartime

A general nuclear war was not considered, since the nuclear capability of the major nations was considered a deterrent to such a large scale conflict. Further, the high consumption, in the event of a forward defense of NATO, would quickly deplete the war reserve. In as much as this use scenario would not lend itself to life cycle predictions, a limited conflict was considered as the most representative scenario for use in this specification.

3.1.2.2 Utilization Factors

The following factors are considered most representative of the deployment and will be updated pending receipt of customer requirements. The use and attrition rates are based on survivability studies and the best estimates available from government and company resources. The number of primary wings utilized refers to the primary carrier aircraft. The number of secondary wings refers to other carrying A/C, assumed to have a primary air-to-ground mission which will carry the XYZ device for defensive purposes only. The secondary wing quantity listed is that number committed to a limited-war and is used to calculate missle expenditures as a factor of life cycle utilization. Peacetime firing rates are anticipated to occur at the rate of one per assigned aircraft every other year. The aircraft attrition rate includes all causes; air-to-air combat, ground-to-air defenses, enemy ground action, aircraft accidents, etc.

Total Wings (primary)	8
Wings (secondary) - engaged in limited war	3
Wings (primary) - engaged in limited war	2
Number of Squadrons per Wing	3

Aircraft per Squadron	24
Length of engagement	12 months
Life Cycle	10 years
Sorties per Aircraft per month (wartime)	40
Sorties duration	1.5 hours
Quantity use per Sortie Rate	1008
Quantity per Aircraft:	
Air superiority aircraft	4
Air-to-ground mission aircraft	2
Firing Rate/Sortie:	
Air Superioridy aircraft	0.005
Air-to-ground mission aircraft	0.001
Aircraft Attrition Rate:	
Air superiority aircraft	0.002
Air-to-ground mission aircraft	0.0025

Note: Due to the anticipated overall low level of air battles, it was assumed that two of the four devices carried by air superiority fighters were used whenever the enemy was engaged in the air. It was also assumed that 75 percent of the devices carried by air-to-ground mission aircraft were used whenever the enemy pressed an aerial attack. For attrition purposes, it was assumed that an average of three of the four devices carried by air superiority fighters were consumed and that an average of one of the devices carried by air-to-ground aircraft were consumed.

3.1.2.3 Expenditures

3.1.2.3.1 Limited War

Air-superiority aircraft-

$$(72)\ (2)\ (40)\ (1.00)\ (2)\ (0.005)\ (12) = 691$$

$$\frac{691}{\text{life cycle}} = 69.1 \text{ yr./life cycle}$$

Air-to-ground mission aircraft

$$(72)\ (3)\ (40)\ (1.00)\ (.75 \times 2)\ (0.001)\ (12) = 155$$

$$\frac{155}{\text{life cycle}} = 15.5 \text{ yr./life cycle}$$

3.1.2.3.2 Attrition (Limited War)

Air-superiority aircraft

$$(72)\ (2)\ (40)\ (1.00)\ (3)\ (0.002)\ (12) = 414.7$$

$$\frac{414.7}{\text{life cycle}} = 41.5 \text{ yr./life cycle}$$

Air-to-ground mission aircraft

$$(72)\ (3)\ (40)\ (1.00)\ (1)\ (0.0025)\ (12) = 259$$

$$\frac{259}{\text{life cycle}} = 26 \text{ yr./life cycle}$$

3.1.2.3.3 Expenditures - Peacetime

$$\frac{(8 \text{ Wings})\ (72 \text{ Aircraft per Wing})}{\text{Every Other Year}}$$

$$\frac{(8)\ (72)}{2} = 288$$

3.1.2.3.4 Total Expended

$$69.1 + 15.5 + 41.5 + 26 + 288 = 440 \text{ per year}$$

3.1.2.4 *Inventory*

The average inventory considered a production rate of 2,500 per year for four years for a total quantity of 10,000. The number expended per year for evaluation/training was added to the number consumed during a limited war, for the life cycle to calculate the average number consumed per year. Comparison of the production rate and the expenditure rate results in a total nearly average inventory for the life cycle equal to: 6080

Considering that 24 percent will be in deep storage, then an average of 578 will be assigned to the primary aircraft wings.

$$(6080)\ (0.76) = 4620.8$$

$$\frac{4620.8}{8} = 577.6 \text{ per Wing (average inventory)}$$

3.1.3 Support System Elements

This section will define the support system elements described in this specification.

Example

The elements required to support the XYZ system are:

Support and Test Equipment
Technical Publications
Personnel and Training
Facilities
Spare and Repair Parts
Transportation, Packaging and Handling
Data File

The requirements for the elements will be established as a result of a support system analysis to be conducted in accordance with _______________ and _______________. The results of the analysis will be documented as specified in paragraph 3.4.

3.1.4 Government Furnished Property List

This section will depict the GFE to be supplied for the support system. It should identify the GFE support equipment to be supplied (detail list at a later phase, only major known items at this time), facilities, training equipment, software, etc.

3.1.5 Operational and Organizational Concepts

3.1.5.1 Required Maintenance Activities

The maintenance activities performed at each level establishes the baseline for contractual commitments on the scope and depth of support products for this support system. Those maintenance activities described in this section should be the result of support engineering analyses as specified by the buyer.

Time change items or candidates for time change should also be included. The requirements should also consider the planning presented in paragraph 3.1.2 since support equipment required for operational tasks (organizational level) may also be required for maintenance tasks. Describe general activities at each level of maintenance (organizational, intermediate, and depot) including estimated frequencies. Do not itemize support system resources since they will fall out in subsequent sections.

Example:

Organizational Level: The following scheduled and unscheduled maintenance activities will be performed on all-up XYZ System. No disassembly or subsequent fault identification will be performed.

Task	Frequency
1. Lifting (to 100 lbs)	Continuously
2. Lifting & Positioning (to 100 lbs)	Per use
3. Loading/Downloading (to 100 lbs)	1 cycle/use
4. Stray Voltage Checks	Before each use
5. Towing/Transporting	12 times/day
6. BIT Interpretation	6 times/day
7. Visual Inspection	Daily

Intermediate Level:

The following maintenance activities will be performed. Frequencies are to be determined.

1. *Fault verification*
2. *Fault isolation to a removable section*
3. *Remove/replace the faulty section*
4. *Verification of an acceptable all-up system*
5. *Towing/transporting*
6. *Visual inspection*

Depot Level:

The following maintenance activities will be performed. Frequencies are to be determined.

1. *Fault verification - all-up system*
2. *Fault isolation to the card/subassembly level*
3. *Remove and replace faulty card/subassembly*
4. *Reassemble/verify acceptable all-up system*
5. *Towing/transporting*
6. *Visual inspection*

Identification of repair vs. discard criteria is to be determined.

3.1.5.2 Other Support Requirements

This section will describe any support requirements not previously specified.

3.2 SUPPORT SYSTEM CHARACTERISTICS

3.2.1 Performance Characteristics

The information presented in the paragraphs of this section will be qualitative and quantitative Support System Baseline Criteria in the same fashion as the equipment system specification presents Design Baseline Criteria. The interface requirements must be allocated between the XYZ System and the Support System. Individual support elements and support element plans will be developed from the information presented in this section. The baseline criteria should consider support requirements for a fully deployed system.

3.2.1.1 General Criteria

3.2.1.1.1 Quantitative Maintainability Requirements

Present the quantitative requirements imposed contractually or as design goals. These should be only those requirements applicable to this support system and not those applicable to a higher tiered system or end item.

Example 1:

The Mean-Time-To-Repair (MTTR) of the XYZ System at organizational level shall be equal to or less than 36 minutes. 95% of all repairs shall not exceed one hour (maximum time to repair).

Example 2:

The Maintenance Manhour per Utilization Hour (MMH/UH) rate for the XYZ System for combined organizational, intermediate and depot level shall be equal to or less than 2.0 when computed in accordance with applicable formula of Section 3.2.3 of this specification.

Example 3:

No preventive maintenance task for the XYZ System shall exceed 35 minutes in duration at the organizational level.

Example 4:

The mean time between maintenance actions for the XYZ System shall be equal to or greater than 18.0 hours when computed in accordance with applicable formulae of Section 3.2.3 of this specification.

3.2.2 Functional Characteristics

3.2.2.1 Support and Test Equipment

Identify Support and Test Equipment functional requirements and estimated quantities required for both operations and maintenance at each level of maintenance. Include peculiar and standard equipment and present its intended use. Peculiar equipment may be presented as design criteria which may be used in preparing requirements data, or when appropriate, the listing may refer to the actual requirements data. Include software programs except publications requirements which are to be identified in Paragraph 3.2.2.1. Major items of equipment may be contract end items and will require their own support system. Identify these requirements within the appropriate paragraphs of Section 3.5 or when appropriate consider a separate support system specification.

Example:

The table presents operational ground equipment and maintenance ground equipment functional requirements and quantities per squadron.

PECULIAR	STANDARD	EQUIPMENT FUNCTION	FUNCTION IDENTIFIED TO:		LEVEL OF MAINT.		QUANTITY PER SQUADRON
			OGE	MGE	O	I	
X	X	*Support device for functional testing and removal of sections/components*	X	X		X	2
X	X	*Assist in transfering between container, maintenance stand, and launcher*	X	X	X	X	3
X	X	*Support motor during installation and removal*		X		X	1
X		*Provide adaptation to nozzle for nozzle removal and installation*		X		X	1
X		*Provide environmental protection during transporting and storage*	X	X	X	X	100
X		*Functional test and fault isolate to logistic replaceable items*	X	X		X	2
X		*Provide protection for the dome during ground handling*	X	X	X	X	30
	X	*Lift and position containerized device*	X	X	X	X	4
	X	*Transport between facilities and flightline*	X	X	X	X	4
	X	*Transport within maintenance and storage facilities*	X	X	X	X	4
X		*Provide handholds for ease of loading/downloading*	X	X	X		

These functions indicated as both peculiar and standard require peculiar adapter to a standard item of equipment.

3.2.2.2 Technical Publications

(NOTE: Technical Publications requirements for the XYZ System are to be determined during later phases).

3.2.2.3 Personnel and Training

(NOTE: Personnel and training requirements for the XYZ System are to be determined during later phases).

3.2.2.4 Facilities

(NOTE: Facilities planning requirements for XYZ System operations and organizational level maintenance are to be determined during later phases).

3.2.2.5 Spare and Repair Parts

(NOTE: The selection and positioning requirements for spare and repair parts are to be determined during later phases).

3.2.2.6 Transportation/Handling/Packaging

(NOTE: The transportation, handling and packaging functional requirements for the XYZ System are to be determined during later phases).

3.2.2.7 Data File (Collection Reporting, Analysis)

(NOTE: The reliability and maintenance data requirements for the XYZ System are to be determined during later phases).

3.2.3 Support System Analysis Criteria

Describe how support system performance will be evaluated. This paragraph will generally be related to the maintainability or support parameters which are contractually required or which must be formally demonstrated. In addition, system analysis models will be specified.

Example 1:

Mean-Time-To-Repair (MTTR) shall be determined from the following equation:

$$MTTR = \frac{\Sigma \lambda m^{T}}{\Sigma \lambda m}$$

where:

T = Maintenance Task Time

λm = Maintenance rate and is equal to:

$$\frac{(P_F)\ (MF)}{MTBF_S}$$

P_F = Probability of item failure assuming a system primary failure

MF = Maintenance factor (predicted maintenance actions per primary failure)

$MTBF_S$ = System Mean-Time-Between-Failure

Example 2:

Maintenance-man-hours per operational hour (MMH/OH) shall be determined from the following equation:

$$MMH/OH = \frac{MMH_{ct} + MMH_{pt}}{OH}$$

where:

MMH_{ct} = Total maintenance-man-hours expended per month for corrective maintenance

MMH_{pt} = Total maintenance-man-hours expended per month for preventive maintenance

OH = Total operating hours per month

Example 3:

Support system cost estimating relationship to be used shall be defined as support costs incurred per equipment operating hour and shall be determined from the following equation:

$$COST/OH - \frac{C_{ts}}{OH}$$

where:

C_{ts} = Total costs expended for support during the period of interest and will at least include:

Spares
Training
Technical Publications
Transportation
Facilities
Maintenance Labor
AGE

OH = Equipment operating hours during period of interest

Example 4:

Mean Time Between Maintenance Actions (MTBMA) for the system shall be determined from the following equation:

$$MTBMA = \frac{1}{MAAR}$$

where:

MAAR = Maintenance action arrival rate for scheduled and unscheduled maintenance.

3.3 Design and Construction

Not applicable

3.4 Documentation

This paragraph shall specify the plan for support system documentation such as specifications, drawings, test plans, and support engineering analyses.

3.5 Logistics

This section will discuss any special logistics requirements for the support system. It will normally be supplied at a later phase.

4.0 Quality Assurance Provisions

Requirements for support system validation/demonstration/verification tests will be described in this section.

Example:

The support systems requirements specified in Section 3 of this specification, shall be evaluated as follows:

Maintainability:

To be determined

Technical Publications:

To be determined

Ground Support Equipment

To be determined

Personnel and Training Evaluation:

To be determined

5.0 Preparation for Delivery

Not applicable

6.0 Notes:

This paragraph is not binding and should be used for remarks pertinent to either the prime equipment or the support system. This can be background information and/or technical clarification.

NOTE: Contract data requirements (CDRL) are not a part of this specification. This document is to specify criteria which defines a support system baseline. CDRL items (for support planning) will use this document as their point of departure.

7.0 APPENDIX

This paragraph/section should be used for the inclusion of analyses/requirements, such as MFA, which are either lengthy and/or technical and which are primarily information justifying or detailing the support system requirements.

SECTION II

Outline for A

LOGISTIC SUPPORT SYSTEM SEGMENT SPECIFICATION

1.0 Scope

This section should be a summary of what is contained herein together with a descriptive title and objective.

Example:

This specification establishes the support requirements for the XYZ System. Support requirements listed herein refer to quantitative and qualitative criteria to be used to develop the following elements of support:

1. *Support and Test Equipment*
2. *Technical Publications*
3. *Personnel and Training*
4. *Facilities*
5. *Spare and Repair Parts*
6. *Transportation, Packaging, and Handling*
7. *Data File (Collection, Reporting and Analysis)*

1.1 PURPOSE

This support system specification was prepared as a control document to provide a central source for the specification of logistic support requirements. It is to be used as the technical baseline document for the development and implementation of Integrated Logsitics Support.

This specification establishes the requirements for the support system services, products, and equipment necessary to support the XYZ System during its projected life cycle.

1.2 USE

The preparation and delivery of each of the discrete elements of support identified herein shall be responsive to the requirements of this document for detailed planning and implementation. Changes shall be coordinated through the ILS program manager.

2.0 Applicable Documents

Itemize those documents and specifications which affect the design of the support system elements. This includes such documents as:

a. System Specification

b. Component End Item Specification

c. Design Specifications

d. Operational and Maintenance Environment Documents

e. Maintainability and Reliability Requirements/Criteria

Example:

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MIL-STD-471	*Maintainability Demonstration*
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Specifications which define the format and content of individual logistic plans or items of support should not be included.

3.0 Requirements. NOTE: Referencing is the approved method for including requirements set forth elsewhere (MIL-STD-490).
3.1 System Definition

This section shall identify the system to be supported and define the support system interfaces. It will define the elements of support to be addressed and any unique logistic support capability which must be developed.

3.1.1 Prime System Description

Present a brief physical and functional description of the equipment to be logistically supported. Emphasize the maintenance characteristics of the equipment. Also include pertinent operational parameters, maintainability and reliability requirements, system safety requirements and any other system design requirements which must be considered in support planning and in the design of the support system.

Example:

The XYZ System is a short range, high performance infrared seeking device, employing proportional navigation to be used by highly maneuvering fighter aircraft. It is sufficiently flexible to provide launch opportunities early and continuously throughout an engagement with a high probability of kill given a launch opportunity. It is optimized for use with several aircraft.

The device weighs approximately 186 pounds; is 7.0 inches diameter; 95 inches long and consists of three (3) removable major sections:

1. Guidance Section
2. Main Section
3. Aft Section

The following paragraphs present section descriptions and considerations for establishing support system requirements.

3.1.1.1 Guidance Section

1. Seeker

The seeker is a quasi-imaging, multi-element, two color, passive IR seeker. The electro-mechanical system, which provides high angular tracking, large gimbal excursions, and fast slew rates, uses a two-gimbal rate gyro stabilized platform with brush type torquers. A refractive 3-element IR telescope is mounted on the stabilized platform and focuses the target energy into a two-color crossed detector array. The detectors are photo-voltaic InSb with color separation by means of filters placed over their respective elements.

The seeker unit, including the window, cooling unit, and housing is separately removable.

2. Cooling Unit

The cooling unit, required for continuous cooling of the detector, consists of a cryogenic expansion engine which receives helium gas supplied by a closed cycle single cylinder compressor operated by a d.c. motor. The expansion engine is located within the detector dewar while the compressor and motor are located on the aft bulkhead of the seeker assembly.

The compressor/motor is accessible after a separation of the seeker assembly.

3. Electronics Unit

The electronics unit contains, in modularized packages, the signal processing functions of acquisition logic, tracking, terminal aim point analysis, and flight control functions. It contains test leads for testing as a unit for fault isolation to a defective module. The total unit is removable from the guidance section and the electronics package can be separately removed from its aluminum cylindrical housing.

4. Flight Control Subsystem

The flight control subsystem utilizes acceleration feedback to minimize the aerodynamic effects in achieving rapid response to the steering commands. The dynamic shaping, summing, isolation and scaling functions use conventional operational amplifier techniques with passive feedback elements. Switching functions will use solid state FET switches.

The flight sensor assembly, accessible after removal of the guidance section, is replaceable as a total assembly. This assembly, consisting of combined yaw and pitch rate gyros, roll rate gyro, accelerometers, and missile timer will be designed to provide the necessary test connections to fault isolate to the defective component.

The electronics, located in the electronics unit, consists of 3 channels: 2 identical acceleration feedback lateral control channels (pitch and yaw) and a roll rate feedback channel.

3.1.1.2 Main Section

1. Structure

The main structure is aluminum, of quadrant construction with the wings formed as an integral part of the fuselage. The four (4) quadrants are assembled with the fuselage frames and primarily riveted together to complete the assembly. This integral construction has the feature of low cost production, but will increase the maintenance time associated with repair of damaged wings.

2. Warhead

The warhead is a blast-fragmentation device employing dual-end simultaneous initiation to achieve a converging pattern of hi-velocity fragments. It is accessible and replaceable from the forward end of the main section after removal of the guidance section.

3. <u>SA&F</u>

The SA&F is attached to the warhead. It will be locked in the safe position during all handling, storing and shipping and can be unlocked upon application of power. Removal or failure of missile power recycles the unit to a safe position unless it has experienced a sustained acceleration prior to power removal. In this case it reaches an irreversible "commit-to-arm" position. The unit can be fired from any of three(3) sources - the proximity fuse, the contact sensors (triggers), or the self-destruct signal from the timer. It operates on 40 VDC, its position (safe or armed) can be seen visually external to the missile, and it can be separately removed from the warhead.

4. <u>Rocket Motor</u>

The rocket motor assembly is 62 inches long, 6.0 inches in diameter, and weighs 74 pounds approximately. It slides into the main fuselage and is fastened to the fuselage near the aft hook. It is a dual thrust level solid propellant device whose grain is bonded to the motor case without the use of released areas or boots. The motor ignitor incorporates a safe-arm device which is located at the forward end of the motor and can be seen visually.

The motor may have a shelf life less than ten (10) years which will require that consideration be given to the logistics requirements due to a time change task.

5. <u>Battery</u>

The power source is a thermal battery package consisting of three (3) batteries.

The battery package will be internally wired including three (3) firing squibs with one (1) external connector. Battery status can be determined visually by noting the color of the heat sensitive paint which is applied to the case.

The battery is accessible either through an access door or after removal of the warhead. It is considered a one-shot device since once activated, the process cannot be reversed nor can the battery be re-charged.

6. Harness

The missile harness, although identified as part of the main section, consists of several sections with a disconnect provided at missile disconnect stations. It will be conventional "Ribbon" harness through the main section except for harness breakouts to individual receptacles. Connectors will be MIL standard connectors, qualified for the environment. The umbilical interface is forward of the front hook - located in the guidance section. A test connector is also included.

The main section harness is expected to be removable and replaceable without the removal of other major components.

3.1.1.3 Aft Section

1. Hydraulic Actuation System (HAS)

The HAS consists of four (4) closed loop, flow-control type electro-hydraulic servos with a common hydraulic power supply housed in a common assembly. Removable control surfaces are connected to four (4) stub shafts individually controlled by each servo. Servo position is sensed by potentiometers which measure angular displacement of the stub shafts and feedback this information to the flight control unit.

Closed circuit hydraulic power is supplied by a free-piston pump which is driven by a catalytic reactor type gas generator which decomposes a blend of hydrazine.

The seals used in the system have a combined storage and use life less than the missile life. This requires the consideration of a time-change maintenance task.

2. Proximity Fuze-

The fuse is an active optical proximity fuse (AOPF) consisting of two (2) identical and interchangeable modules. Each module consists of two transmitting source elements and two receiving sensor elements to achieve 360° coverage. The AOPF modules are installed around the rocket motor blast tube, and are accessible for maintenance after removal of the aft section.

A sharply defined intercept range is achieved by trangulation. The transmitter beam is tilted forward while the receiver optics are displaced slightly aft. Intersection of the two fields of view provides target range definition.

3.1.1.4 Launcher

Launcher definition is to be determined due to the multiple interface requirements. The following provides a general description of the two (2) ultimately required launching techniques.

3.1.1.4.1 Rail Launch

The rail launcher will weigh approximately 40 pounds and be capable of providing missile installations on both wing and fuselage with single or multiple mounts. It will contain mechanisms for umbilical separation, an electronic unit, and hold back restraints. The umbilical plug will retract at launch blast. The launcher will also be capable of ejection from the aircraft.

3.1.1.4.2 Ejection Launch

The ejection launcher will contain an electronic unit, attach points, and dual ejector mechanisms. The driving force of the ejection pistons will be supplied by a "clean" gas generating system designed to minimize post-firing maintenance. It is estimated that the ejector launcher (including gas generator) will weigh 85 pounds.

3.1.5 Reliability

Table 2-1 presents the allocated reliability criteria, the subsystem/unit weights, and the probability of unit failure given that there is a failure. The reliability criteria are "stressed" to the environment but do not include secondary failures or failures induced due to maintenance or handling.

Table Reliability and Weight Criteria

Component	MTBF (1) (Hours)	P_s	P_F	Weight (lbs)
Guidance Section			.718	24
Seeker/Tracker	7,500	.99960	.047	
Cryogenic Unit	923	.99675	.378	
Data Processor	4,225	.99929	.092	
Gyros	6,383	.99953	.065	
Flight Sensor Assy	6,383	.99953	.065	
Flight Control Electronics	6,818	.99956	.051	
Structure	--	--	.020	
Main Section			.144	140
Battery	NA	--	.015	
Rocket Motor & ISM	NA	--	.015	
Warhead and SAF	NA	--	.015	
Harness/Umbilical	12,000	.99975	.029	
Structure	--	--	.070	
Aft Section			.138	23
Prox Fuses	7,143	.99958	.049	
HAS/Flippers	--	--	.089	
Total	468	.9936	1.00	187

MTBF = Mean Time Between Failures in Captive Flight (3 hr)

P_s = Probability of success during 3 hr captive flt

P_F = Probability of component failure given that there is a failure

(1) = Includes BIT detected failures

NA = Not applicable - irreversible functions

3.1.2 Missions

Present, in narrative form, how the equipment is to be used including scenarios for both war and peace. Discuss the use environments at all levels including critical maintenance functions which are fixed and not subject to the decision making process or to tradeoff. Also include expected number of systems deployed, the number of operational and maintenance installations, quantity of systems per installation. The criteria should be sufficient to establish a baseline generator for maintenance requirements.

Example:

The device will be used to obtain and maintain air superiority during wartime and for evaluation/training during peacetime. Two wartime situations were analyzed to obtain data applicable to missile life cycle utilization and subsequent logistic support calculations. The philosophy applied herein is in accordance with the President's "1-1/2 War" strategy designed to meet a major Communist threat in either Europe or Asia and to support our allies against external aggression.

3.1.2.1 Environment

3.1.2.1.1 Forward Location

The forward location is considered the worst case environment for the XYZ System. It is an austere operation dictated by the fact that all resources must either be airlifted or supplied by sea and is primarily a wartime situation designed for approximately a short duration. Work shop space is crowded, stored equipment may have minimal protection from the elements, and operations are completely exposed to weather conditions. Quantities of AGE are limited to essential requirements due to airlift allocation restrictions and operational space restrictions. Forward location operations are normally restricted to organizational level tasks.

3.1.2.1.2 Established Bases

Peacetime operation was assumed for established CONUS bases and a combination of peacetime and wartime operations assumed for established overseas bases. Evaluation/training operations were assumed to be conducted at training bases. No unique operational or maintenance environmental difficulties are anticipated while operating from established bases. Consequently, operational deployment can be more easily predicted.

Evaluation/training are assumed to be assigned to

primary aircraft with secondary aircraft training accomplished with flight simulators.

3.1.2.1.3 Wartime

A general nuclear war was not considered, since the nuclear capability of the major nations was considered a deterrent to such a large scale conflict. Further, the high consumption, in the event of a forward defense of NATO, would quickly deplete the war reserve. In as much as this use scenario would not lend itself to life cycle predictions, a limited conflict was considered as the most representative scenario for use in this specification.

3.1.2.2 Utilization Factors

The following factors are considered most representative of the deployment and will be updated pending receipt of customer requirements. The use and attrition rates are based on survivability studies and the best estimates available from government and company resources. The number of primary wings utilized refers to the primary carrier aircraft. The number of secondary wings refers to other carrying A/C assumed to have a primary air-to-ground mission and will carry the XYZ device for defensive purposes only. The secondary wing quantity listed is that number committed to a limited-war and is used to calculate missile expenditures as a factor of life cycle utilization. Peacetime firing rates are anticipated to occur at the rate of one per assigned aircraft every other year. The aircraft attrition rate includes all causes; air-to-air combat, ground-to-air defenses, enemy ground action, aircraft accidents etc.

Total Wings (Primary)	8
Wings (Secondary) - engaged in limited war	3
Wings (Primary) - engaged in limited war	2
Number of Squadrons per Wing	3
Aircraft per Squadron	24
Length of engagement	12 months
Life Cycle	10 years
Sorties per Aircraft per month (wartime)	40
Sorties duration	1.5 hours

Quantity use per Sortie Rate	1008
Quantity per Aircraft:	
Air superiority aircraft	4
Air-to-ground mission aircraft	2
Firing Rate/Sortie:	
Air superiority aircraft	0.005
Air-to-ground mission aircraft	0.001
Aircraft Attrition Rate:	
Air superiority aircraft	0.002
Air-to-ground mission aircraft	0.0025

Note: Due to the anticipated overall low level of air battles, it was assumed that two of the four devices carried by air superiority fighters were used whenever the enemy was engaged in the air. It was also assumed that 75 percent of the devices carried by air-to-ground mission aircraft were used whenever the enemy pressed and aerial attack. For attrition purposes, it was assumed that an average of three of the four devices carried by air superiority fighters were consumed and that an average of one of the devices carried by air-to-ground aircraft were consumed.

3.1.2.3 Expenditures

3.1.2.3.1 Limited War

Air-superiority aircraft

$$(72)\ (2)\ (40)\ (1.00)\ (2)\ (0.005)\ (12) = 691$$

$$\frac{691}{\text{life cycle}} = 69.1 \text{ yr./life cycle}$$

Air-to-ground mission aircraft

$$(72)\ (3)\ (40)\ (1.00)\ (.75 \times 2)\ (0.001)\ (12) = 155$$

$$\frac{155}{\text{life cycle}} = 15.5 \text{ yr./life cycle}$$

3.1.2.3.2 Attrition (Limited War)

Air-superiority aircraft

(72) (2) (40) (1.00) (3) (0.002) (12) = 414.7

$$\frac{414.7}{\text{life cycle}} = 41.5 \text{ yr./life cycle}$$

Air-to-ground mission aircraft

(72) (3) (40) (1.00) (1) (0.0025) (12) = 259

$$\frac{259}{\text{life cycle}} = 26 \text{ yr./life cycle}$$

3.1.2.3.3 Expenditures - Peacetime

$$\frac{\text{(8 Wings) (72 Aircraft per Wing)}}{\text{Every Other Year}}$$

$$\frac{(8)\ (72)}{2} = 288$$

3.1.2.3.4 Total Expended

69.1 + 15.5 + 41.5 + 26 + 288 = 440 per year

3.1.2.4 Inventory

The average inventory considered a production rate of 2,500 per year for four years for a total quantity of 10,000. The number expended per year for evaluation/training was added to the number consumed during a limited war, for the life cycle to calculate the average number consumed per year. Comparison of the production rate and the expenditure rate results in a total yearly average inventory for the life cycle equal to: 6080

Considering that 24 percent will be in deep storage, then an average of 578 will be assigned to the primary aircraft wings.

(6080) (0.76) = 4620.8

$$\frac{4620.8}{8} = 577.6 \text{ per wing (average inventory)}$$

3.1.3 Support System Elements

This section will define the support system elements in this specification.

Example:

The elements required to support the XYZ system are:

Support and Test Equipment
Technical Publications
Personnel and Training
Facilities
Supply Support
Transportation, Packaging and Handling
Data File

The elements will be developed in accordance with the documented support system analysis and in accordance with the specifications listed for each element in paragraph 3.3.

3.1.4 Government Furnished Property List

This section will depict the GFE to be supplied for the support system. It will specify the support equipment, facility, items, training equipment, software, publications, and type of spares to be supplied by the government.

3.1.5 Operational Organizational Conce

3.1.5.1 Required Maintenance Activities

The maintenance activities performed at each level establishes the baseline for contractual commitments on the scope and depth of support products for this support system. Those maintenance activities described in this section should be the result of support engineering analyses as specified by the buyer.

Time change items or candidates for time change should also be included. The requirements should also consider the planning presented in paragraph 3.1.2 since Support Equipment required for operational tasks (organizational level) may also be required for maintenance tasks. Describe general activities at each level of maintenance (organizational, intermediate, and depot) including estimated frequencies. Do not item support system resources since they will fall out in subsequent sections.

Example:

Organizational Level: The following scheduled and unscheduled maintenance activities will be performed on the all-up XYZ System. No disassembly or subsequent fault identification will be performed.

	Task	U	S	Frequency
1.	Lifting (to 100 lbs)	X		Continuously
2.	Lifting & Positioning (to 100 lbs)	X	X	Per use
3.	Loading/Downloading (to 1000 lbs)	X		1 cycle/use
4.	Stray Voltage Checks		X	Before each use
5.	Towing/Transporting	X	X	12 times/day
6.	BIT Interpretation	X	X	6 times/day
7.	Visual Inspection		X	Daily

Intermediate Level: The following scheduled and unscheduled maintenance activities will be performed.

	ITEM	TASK(S)	U	S	TASK FREQUENCY 1000 HRS	DISPOSITION OF REMOVED PART
1.	Antenna	Fault isolate to next indenture level	X		30	Return to depot
2.	Transmitter	Fault isolate to next indeture level	X		50	Return to depot
3.	Assembly A	Remove and replace	X		10	Return to depot
4.	Assembly B	Remove and replace	X		2	Repair at intermediate
5.	Assembly C	Discard	X		1	

Depot Level: The following scheduled and unscheduled maintenance activities will be performed.

	ITEM	TASK(S)	U	S	TASK FREQUENCY PER 1000 HRS	DISPOSITION OF REMOVED PART
1.	Assembly A	Fault isolate & repair	X		10	Discard
2.	Assembly B	Fault isolate & repair	X		2	Discard
N	Assembly XY	Fault isolate & replace defective piece part	X		1.7	Discard

The depot shall also be capable of performing those maintenance activities normally assigned to the intermediate level.

3.1.5.2 Other Support Requirements

This section will describe any support requirements not previously specified.

3.2 SUPPORT SYSTEM CHARACTERISTICS

3.2.1 Performance Characteristics

The information presented in the paragraphs of this section will be qualitative and quantitative Support System Baseline Criteria in the same fashion as the equipment system specification presents design baseline criteria. The interface requirements must be allocated between the XYZ system and the support system. Individual support elements and support element plans will be developed from the information presented in this section. The baseline criteria should consider support requirements for a fully deployed system.

3.2.1.1 General Criteria

3.2.1.1.1 Quantitative Maintainability Requirements

Present the quantitative requirements imposed contractually or as design goals. These should be only those requirements applicable to this support system and not those applicable to a higher tiered system or end item.

Example 1:

The Mean-Time-To-Repair (MTTR) of the XYZ System at organizational level shall be equal to or less than 36 minutes. 95% of all repairs shall not exceed one hour (maximum time to repair).

Example 2:

The Maintenance Manhour per Utilization Hour (MMH/UH) rate for the XYZ System for combined organizational, intermediate and depot level shall be equal to or less than 2.0 when computed in accordance with applicable formulae of Section 3.2.3 of this specification.

Example 3:

No preventive maintenance task for the XYZ System shall exceed 35 minutes in duration at the organizational level.

Example 4:

The mean time between maintenance actions for the XYZ System shall be equal to or greater than 18.0 hours when computed in accordance with applicable formulae of Section 3.2.3 of this specification.

3.2.2 Functional Characteristics

3.2.2.1 Support and Test Equipment

Identify Support and Test Equipment functional requirements and estimated quantities required for both operations and maintenance at each level of maintenance. Include peculiar and standard equipment and present its intended use. Peculiar equipment may be presented as design criteria which may be used in preparing requirements data, or when appropriate, the listing may refer to the actual requirements data. Include software programs except publications requirements which are to be identified in Paragraph 3.2.2.1. Recognize that major items of equipment may be contract end items and will require their own support system. When this exists, identify these requirements within the appropriate paragraphs of Section 3.5 or when appropriate consider a separate support system specification.

Example:

The table presents operational ground equipment and maintenance ground equipment functional requirements and quantities per squadron. These requirements are design criteria and shall be reflected in the design specifications.

PECULIAR	STANDARD	EQUIPMENT FUNCTION	LEVEL OF MAINTENANCE O	LEVEL OF MAINTENANCE I	QUANTITY PER SQUADRON
X	X	Support device for functional testing and removal of sections/ components		X	2
X	X	Assist in transfering between container, maintenance stand, and launcher	X	X	3
X	X	Support motor during installation and removal		X	1
X		Provide adaptation to nozzle for nozzle removal and installation		X	1
X		Provide environmental protection during transportation and stroage	X	X	100
X		Functional test and fault isolate to logistic replaceable items		X	2
X		Provide protection for the dome during ground handling	X	X	30
	X	Lift and position containerized device	X	X	4
	X	Transport between facilities and flightline	X	X	4
	X	Transport within maintenance and storage facilixies	X	X	4

P E C U L I A R	S T A N D A R D	EQUIPMENT FUNCTION	LEVEL OF MAINTENANCE O	I	QUANTITY PER SQUADRON
X		*Provide handholds for ease of loading/downloading*	X		

Those functions indicated as both peculiar and standard require peculiar adapter to a standard item of equipment.

3.2.2.2 Technical Publications

Itemize the type document required at each level of maintenance by specific title and/or technical order dash number. Identify specifications where applicable. Present general scope of content including the extent to which "theory of operation" is required to assure compatibility with level of maintenance requirements and the maintenance engineering analysis.

Example:

Technical Publications for the XYZ System shall be prepared in accordance with the following:

TITLE	PER SPEC.	MAINT. LEVEL O	I	O	GENERAL CONTENT
Inspection and service requirements for the XYZ System	MIL-H-1234	X			*To cover scheduled/unscheduled tasks accomplished at/or aircraft IAW the* logistic support *analysis*
Maintenance and repair of the XYZ System	MIL-H-5678		X		*To cover unscheduled maintenance to be done on the XYZ System LRUs (WRAs) at "I" level TAW the* logistic support analysis
Packaging, handling and transportation of the XYZ System	MIL-H-6789	X	X	X	*To cover preparation for shipping, storage requirements, safety considerations thru all modes of handling/transportation*

TITLE	PER SPEC.	MAINT. LEVEL. O	I	D	GENERAL CONTENT
Fault isolating & repair of XYZ System modules	Contractor Standard		X	X	To cover use of automatic tester including software programs

3.2.2.3 Personnel and Training

Describe course requirements in terms of skills and knowledge to perform tasks previously defined (Section 3.1.5.1) and where applicable, include training standards consistent with the quantitative requirements of Section 3.2.1.1. Identify new personnel classifications, if any, which require training or identify new skills required by existing personnel classifications. Major items of training equipment should be functionally identified. Identify the anticipated manning levels for organizational/intermediate considering both operations and maintenance.

Example:

Personnel Requirements

The following manning levels are required to maintain the XYZ System on a per squadron basis during its useful life.

PERSONNEL CLASSIFI-CATION	TITLE	XYZ SYSTEM TASK	*/SQUADRON
32271	Weapons Control Systems Technician	Electronics interface checkout	6
46250	Weapons Mechanic	Device/launcher flight-line operations and maintenance	10
31651	Guidance and Control Technician	Device and Support and Test Equipment Intermediate maintenance	4
Contractor Representative	Field Service Technician	Assist user in XYZ System maintenance. Conduct OJT	1

"This quantity reflects the results of the maintenance task analysis and does not necessarily reflect authorized manning levels for either a service unit or an operating unit.

Training Requirements

Operations and maintenance personnel associated with the XYZ System shall be trained in grade to meet the following criteria. All training [illegible] d indoctrination shall be considered "new", however, no requirement exists for the creation of new personnel classifications.

PERSONNEL CLASSIFI-CATION	TRAINING REQUIREMENTS	TRAINING AIDS
Aircrew	Display interpretation Cockpit familiarization BIT Operation and interpretation Malfunction recognition and corrective action	Cockpit Trainer
32271	XYZ System theory of operation BIT operation and interpretation Interface c/o procedure Malfunction recognition and correction action Familiarization w/loading and offloading procedures	(No unique training hardware)
46250	Operation and maintenance of loading GSE Loading and offloading procedures Preflight checks and inspections Safety precautions and Built In features	Simulated Weight/C.G. Loading Trainer
31651	XYZ System theory of operation System assembly and disassembly techniques Fault isolation and repair procedures (to level authorized by LSA) Tester operation and maintenance (to level authorized by LSA)	Maintenance Training Device
Contractor Representative	Must be familiar with and be trained in each of the above specialties	

Depot Maintenance:

Depot training requirements are to be established during the augmented support period.

3.2.2.4 Facilities

Define space, utilities, mobility and environmental requirements. Specify these requirements for operations and for each level of maintenance. Define activity which will be performed including storage for spare and repair parts and accommodations required for personnel and equipment. All items included in definition of facilities (Part II) should be considered in the development of facilities and site activation plans.

Example: *(NOTE: This example is for one location only)*

Facilities planning for XYZ System Operations and organizational level maintenance shall consider the following requirements.

LOGISTIC ITEM	FACILITY REQUIREMENTS			
	SPACE	UTILITIES	ENVIRONMENT PROTECTION	MOBILITY
Personnel: Officers/ enlisted	Billeting for 13 officers and 30 enlisted	Standard	Maintain housing at 72°F and 30% R.H.	See TACAF deployment
Maintenance activity	100 ft.^{2} at each stores station unobstructed	A/C power and portable power required 28VDC 440V 30 60Hz	All climatic extremes per MIL-STD	N/A
Maintenance equipment	Undercover storage for 10 items of GSE. 400 ft.^{2} and 4000 ft.^{3}	Power: 115V 30 60HZ	Protect from sand, wind, rain. Temperature 40°F 110°F	See TACAF deployment planning for XYZ System
Spare and Repair parts	Undercover storage Explosives: 2000 ft.^{2} and 20,000 ft.^{3} Nonexplosives: 4,000 ft^2 and 40,000 ft.^{3}	Power: 115V 31 60Hz Water: 85 psi supply	Explosives: per MIL-STD Nonexplosive: Temperature control 65°F 80°F	N/A

3.2.2.5 Spare and Repair Parts

Define provisioning/stockage criteria considering the prime equipment deployment and level of repair analysis. This paragraph should be a general description of the factors to be employed in selecting the quantity and type of parts to be stocked at each level of maintenance. Specify "K" factors applied to MTBMA/MTBF predicitions, the protection levels required and, where applicable, the specific models to be used for provisioning. Refer to interface required with MEA and level of maintenance requirements specified in Paragraph 3.1.5.1. This is not to be a parts list with quantities and locations, but rather the "rules" governing these determinations.

Example:

The selection and positioning of spare and repair parts shall be in accordance with the level of repair requirements specified in Paragraph 3.1.2, the Logistic Support *Analysis (Appendix A), and shall use the following criteria:*

ORGANIZATIONAL:

Protection level: Items shall be packaged per MIL-E-17555 to level A

Operational Ready Rate: The squadron ready rate, while utilizing the XYZ System, shall not be less than 90%

NRTS: Provisioning shall consider that the not-reparable-this-station rate is predicted to be 25-30%

Demand Rate: The mean-time-between-maintenance-actions (MTBMA) provided by the MEA shall be the point of departure for spares determinations. The quantities and mix of parts shall be such that a 95% probability of a part being available upon demand exists.

Model: The ABC model is recommended for spares determinations. Suggested deviations to this process or other analytical techniques may be used subject to approval by the ILS manager.

3.2.2.6 Transportation/Packaging/Handling

Specify environmental criteria which must be considered for the design of TPH equipment in support of the prime equipment at all levels of maintenance. This criteria should be based on the deployment analysis and on the Repair Level Analysis wherein each mode of use is identified. Specify T-P-H considerations peculiar to the prime equipment at each level of maintenance, for each anticipated mode of use, and between modes of use. Include time in storage with the environmental

criteria.

Example:

The transportation, handling and packaging functional requirements for the XYZ System are presented in the table. These requirements apply to the movement of the XYZ System between sites.

REQUIREMENTS / MODE OF USE	CONTRACTOR TO SUPPLY POINT	SUPPLY POINT TO BASE	BASE TO DEPOT	STORAGE
Transport	Protect system while being transported by truck or rail	Protect system while being transported by air. Airlift packages to meet deployment criteria	Same as column 2 however air-lift modularized requirements need not apply	N/A
Packaging	System packaging to meet requirements of MIL-P-116 and electronic component packaging to meet MIL-E-17555 level A	Protect system while being transported by air. Airlift packages to meet deployment criteria	Same as column 2 however airlift modularized requirements need not apply	Packaging shall be sufficient to withstand the environmental extremes of MIL-STD- for up to 5 years
Handling	Provide capability of loading/unloading XYZ System with standard forklift. Major assemblies shall allow for ease of handling by 2 men	Protect system while being transported by air. Airlift packages to meet deployment criteria	Same as column 2 however airlift modularized requirements need not apply. Packaged components shall not exceed 35 lbs/package and handholds shall be provided	N/A

3.2.2.7 Data File (Collection Reporting, Analysis)

Define the field data requirements for the total program and how the information is to be obtained and utilized. Suggest a matrix which contains the following by program phase: (should include customer and contractors forms).

Type form - title and form number if available

Data to be recorded - if no form available

Who records

Action by whom

Data Repository

Purpose of data

The intent is to specify a data system which will provide operational and maintenance history on the equipment which can be used for support system verification, product/logistics improvement and provide a credible data base for future designs and life cycle cost prediction/simulation.

Example:

The reliability and maintenance data requirements for the XYZ System shall be in accordance with the matrix presented below. These data shall be collected on a common form, designed for electronic data processing, and shall be compatible with the standard work unit codes and MIL-M-38768.

The data collection, analysis, and reporting procedure shall be closed loop requiring periodic assessment for justification of change requests.

DATA ITEM	Clarification	DEV.	PROD.	OPER.
Equipment Identification:	Title, Part Number and Serial Number	X	X	X
Time on Equipment:	Time in hours, days, cycles whichever is applicable	X	X	X
Date of Action:	Date failure or maintenance action occurred	X	X	X
Affected Component Part No., Serial No., and Name:	Refers the item removed and/or repaired	X	X	X
Manufactured by:	Self explanatory	X	X	X
Time on Component:	Spell out accumulated time in hours, days or cycles - which - ever applies	X	X	X
Identification by Circuit Loaction:	To identify a particular location in the event component/pieces part is used in several places	X		
Description and/or Symptom of Failure	This essentially "How Mal" failure codes may be used	X	X	X
Description of Logistic Action:	In the event the action taken to the equipment is not due to a failure (i.e. maintainability demonstration), briefly describe	X	X	X
Fault Location Time:	Record and enter the time to identify the problem	X	X	
Fault Correction Time:	That element of time during which a failure is corrected by: Repairing in place; removing and replacing with a like item; or removing, repairing and reinstalling	X	X	
Maintenance Down Time:	The duration of time in which the primary effort is halted due to maintenance - including waiting for parts or instructions	X	X	

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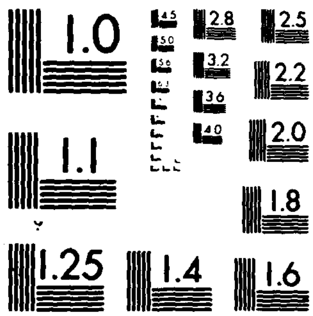

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

DATA ITEM	CLARIFICATION	DEV.	PROD.	OPER.
Reason for Down Time:	Explain	X	X	
Severity of Failure	Categorize as follows:	X	X	X
Catastrophic	Any failure which could result in death or injuries or prevent performance of the mission			
Critical	Any failure which will degrade the system beyond acceptable limits and could create a safety hazard			
Major	Any failure which will degrade the system but which can be counteracted or controlled adequately and safely			
Minor	All others			
Categroization of Failure:	Primary, secondary due to primary handling, environmental, etc. Use "How Mal" code	X	X	X
Action Suggested to Avoid Repetition of the Problem:	Self explanatory	X	X	
Parts Replaced:	Itemization of parts replaced	X	X	X
Test Equipment and Tools Utilized:	Name and/or description	X	X	
Personnel Utilized:	The actual number and skill level of people required to affect the repair or logistic action	X		
Adequacy of Repair or Logistic Instructions/Procedures:	This can be coded to provide an insight as to availability and adequacy		X	X

3.2.3 Support System Analysis Criteria

Describe how support system performance will be evaluated. This paragraph will generally be related to the maintainability or support parameters which are contractually required or which must be formally demonstrated. In addition, system analysis models will be specified in this section.

Example 1:

Mean-Time-To-Repair (MTTR) shall be determined from the following equation:

$$MTTR = \frac{\Sigma\lambda m^T}{\Sigma\lambda m}$$

where:

T = *Maintenance Time*

λm = *Maintenance rate and is equal to:*

$$\frac{(P_F)\ (MF)}{MTBF_S}$$

P_F = *Probability of item failure assuming a system primary failure*

MF = *Maintenance factor (predicted maintenance actions per primary failure)*

$MTBF_S$ = *System Mean-Time-Between-Failure*

Example 2:

Maintenance-man-hours per operational hour (MMH/OH) shall be determined from the following equation:

$$MMH/OH = \frac{MMH_{ct} + MMH_{pt}}{OH}$$

where:

MMH_{ct} = *Total maintenance-man-hours expended per month for corrective maintenance*

MMH_{pt} = *Total maintenance-man-hours expended per month for preventive maintenance*

OH = *Total operating hours per month*

Example 3:

Support system cost estimating relationship to be used shall be defined as support costs incurred per equipment operating hour and shall be determined from the following equation:

$$COST/OH = \frac{C_{ts}}{OH}$$

where:

C_{ts} = *Total costs expended for support during the period of interest and will at least include:*

Spares
Training
Technical Publications
Transportation
Facilities
Maintenance Labor
AGE

OH = *Equipment operating hours during period of interest*

Example 4:

Mean Time Between Maintenance Actions (MTBMA) for the System shall be determined from the following equation:

$$MTBMA = \frac{1}{MAAR}$$

where:

MAAR = *Maintenance action arrival rate for scheduled and unscheduled maintenance*

3.3 Design and Construction

This paragraph shall specify minimum system design and construction standards which have general applicability to system equipment and are applicable to major classes of equipment or are applicable to particular design standards. These requirements shall be specified by incorporation of the established military standards and specifications. Requirements which add to, but do not conflict with requirements specified herein, may be included in individual configuration item specifications. In addition, this paragraph shall specify criteria for the selection and imposition of specifications and standards.

3.4 Documentation

This paragraph shall specify the plan for support system documentation such as specifications, drawings, test plans and procedures and support Engineering Analysis.

3.5 Integrated Logistics

This section will specify any special logistics requirements for the support system. Examples of equipment requiring further definition of logistics requirements include major automatic test equipment, a set of maintenance trainers, or an operational flight trainer. The program manager must decide whether to specify the support requirements in this specification or go to a separate document. This section will be structured as follows with information similar to that specified for the prime system in paragraph 3.2.

3.5.1 Performance Characteristics

3.5.2 Physical Characteristics

3.5.2.1 Support Equipment

3.5.2.2 Supply

3.5.2.3 Facilities and Facility Equipment including Site Activation

3.5.2.4 Personnel and Training

3.5.2.5 Technical Publications

3.6 Precedence

This paragraph shall either specify the order of precedence of requirements or assign weights to indicate the relative importance of characteristics and other requirements. It shall also establish the order of precedence of this specification relative to referenced documents.

4.0 Quality Assurance Provisions

Specify those test demonstration/validation requirements for the support system necessary to assure to some degree of confidence that the primary system can be logistically supported within all the constraints of environment, economy, etc. Support system V/D/V requirements should be listed as applicable, for:

a. Maintainability Demonstration

b. Manuals Validation/Verification

c. Support and Test Equipment Evaluation

d. Transportation/Handling Demonstration

e. Personnel and Training Evaluation

f. Verification of Supply Support Provisions

Example:

The support system requirements specified in Section 3 of this specification, shall be evaluated as follows:

Maintainability:

The XYZ System maintainability predictions and the general maintenance features of the system shall be evaluated by subjecting the system to a maintainability test. This test shall be designed, conducted and the results evaluated in accordance with MIL-STD-471.

Technical Publications:

Technical publications prepared for the XYZ System shall be validated concurrently with the preparation of the publications and shall be verified prior to delivery utilizing production equipment per the intent of MIL-Q-9858A.

These requirements also apply to data and publications provided by suppliers.

Ground Support Equipment:

Ground support equipment planning shall include tests wherein the capability and repeatability of the support equipment is demonstrated either in a simulated or actual environment. These tests shall be in addition to those required for qualification and MIL-Q-9858A.

Personnel and Training Evaluation:

The completeness of the personnel requirements and adequacy of the training requirements, specified in Paragraph 3.3 shall be evaluated. This evaluation may be a separate program or may be integrated with the above support system validation tests.

5.0 PREPARATION FOR DELIVERY

Define any unique requirements pertinent to the delivery of the specified support system. Note that the transportation/handling/packaging requirements specified in Paragraph 3.8 pertain to the prime equipment. Examples of items to be included would be:

a. Delivery of GSE

b. Delivery of Publications

c. Delivery of Spares/Repair Parts

d. Training Equipment

Example:

The following information shall be considered as packaging design criteria peculiar to the noted item of support. Specific instructions for delivery will be as negotiated in the contract.

Test Equipment:

Equipment utilized for testing of electronic systems, subsystems and components shall be packaged for delivery and storage world wide. Consideration shall be given to modularization of equipment to ease meeting the rapid deployment requirements specified in the system operations requirement. Basic packaging of electronic equipment shall meet MIL-E-17555 and MIL-P-116.

Equipment utilized for handling/support shall be packaged for delivery and storage world wide per MIL-P-116.

Spare and Repair Parts

Meet the requirements of Paragraph 3.2.2.6.

Technical Publications

Delivery of reproducible copy shall be as sepcified in the contract.

Training Equipment

This equipment shall be packaged for delivery and use within CONUS only. XYZ System trainers which simulate the basic system shall be packaged in accordance with Paragraph 3.2.2.6 requirements. Other training equipment shall be packaged by standard commercial practice.

6.0 NOTES

This paragraph is not binding and should be used for remarks pertinent to either the prime equipment or the support system. This can be background information and/or technical clarification.

Note: Contract data requirements (CDRL) <u>are</u> <u>not</u> a part of this specification. This document is to specify criteria which defines a support system baseline. CDRL items (for support planning) will use this document as their point of departure.

Example:

1) Reparability decisions (repair or discard-at-failure) will be based upon an economic analysis.

2) The XYZ System may be a tri-service procurement - - - therefore, the support system should reflect this probability.

3) Test and handling equipment, designed to meet the functional requirements of Paragraph 3.1.5.1 will reflect utilization of equipment presently in the inventory.

7.0 APPENDIX

This paragraph/section should be used for the inclusion of analyses/requirements, such as MFA, which are either-lengthy and/or technical and which are primarily information justifying or detailing the support system requirements.

Example:

The table presents the initial maintainability apportionment and prediction for the XYZ System. The detail analysis may be found in report no. XYZ-21671.

(U) Apportionment and Prediction Summary

UNIT	P_F	*MTBF*	*MF*	*MTBMA*	$M^{(10-6)}$	*T*	M^T	*N*	*N* M^T
Seeker Assembly	0.471	255	2.5	100	9,840	1.5	14,760	2	
Seeker Assembly Structure	0.02	6,000	4	1,500	666	1.4	932	2	
Electronics Package	0.082	1,460	2.5	584	1,720	1.7	2,924	2	
Umbilical/ Harness	0.043	2,790	2.5	1,116	890	2.5	2,225	2	
Control Sensor Assembly	0.051	2,350	2.5	940	1,060	1.4	1,484	2	

UNIT	P_F	MTBF	MF	MTBMA	$M^{(10-6)}$	T	M^T	N	$N_M T$
Guidance Section Structure	0.01	12,000	4	3,000	333	1.8	599	2	
Battery	0.017	7,050	2.5	2,820	354	1.5	531		
Warhead/SAF	0.017	7,050	2.5	2,820	354	1.3	460	2	
Motor	0.017	7,050	2.5	2,820	354	3.2	1,132	2	
Main Section Structure	0.045	2,660	4	665	1,500	1.3	1,950	2	
HAS	0.085	1,410	2.5	564	1,760	1.9	3,344	2	
Fuzes	0.031	3,880	2.5	1,552	645	1.8	1.161	2	
Aft Section Structure	0.01	12,000	4	3,000	333	0.8	266	2	
Total	1.00	120			19,809		31,768		63,500

$$MTBMA = \frac{MTBF}{MF}$$

$$MTBF = \frac{MTBF_S}{P_F} = \frac{120}{P_F}$$

$$MTTR = \frac{\Sigma\lambda m^T}{\Sigma\lambda m} = \frac{31,768}{19,809} = 1.6$$

$$\lambda m = \frac{(P_F)\ (M_F)}{MTBF_S}$$

$$MMH/UH = \frac{\Sigma NT\lambda M-}{\Sigma\lambda M} - \frac{N_T}{UH} = \frac{63,500}{19,800}\ \frac{0.02}{0.46} = 0.14$$

APPENDIX B

GLOSSARY OF TERMS

This section defines words and phrases of broad application as they are used in this Integrated Logistic Support Planning Guide. Other general terms used are defined in DOD publications or standard dictionaries. More specialized terms will be defined where they are used in the guide.

Acquisition - The process consisting of planning, designing, producing, and distributing a weapon system/equipment. Acquisition in this sense includes the conceptual, validation, full scale development, production, and deployment/operational phases of the weapon systems/equipment project. For those weapon systems/equipments not being procured by a project manager, it encompasses the entire process from inception of the requirement through the operational phase.

Availability - A measure of the degree to which an item is in the operable and committable state at the start of the mission, when the mission is called for at an unknown (random) point in time.

Advanced Development - The advance development period is the period in which the major program characteristics (technical, logistic cost and schedule), through extensive analysis and hardware developments are validated, primarily by the contractor(s) who will do the full scale development. The validation includes commitments that contractors are willing to make (i.e., contracts they will sign on these major program characteristics).

Base Line. A configuration identification document or a set of such documents formally designated and fixed at a specific time during a CI's life cycle. Base lines, plus approval changes from those base lines, constitute the current configuration identification.

Conceptual Effort. The Conceptual Effort is the initial activity in the weapon system life cycle. During this effort, the broad technical, logistic, military, and economic bases for an acquisition program are established through comprehensive system studies and experimental hardware development and evaluation.

Capability. A measure of the ability of an item to achieve mission objectives given the conditions during the mission.

Configuration Control. The systematic evaluation, coordination, approval or disapproval, and implementation of all approved changes in the configuration of a CI after formal establishment of its configuration identification.

Configuration Management. A discipline applying technical and administrative direction and surveillance to (1) identify and document the functional and physical characteristics of a configuration item, (2) control changes to those characteristics, and (3) record and report change processing and implementation status.

Cost Analysis. A systematic procedure for estimating the aggregate cost of a system/equipment, and for comparing the costs of alternative systems in order to determine the relative economy and effectiveness of the alternatives.

Cost Effectiveness. A comparative evaluation derived from analyses of alternatives (actions, methods, approaches, equipment, weapon systems, support systems, force combinations, etc.) in terms of the interrelated influences of cost and effectiveness in accomplishing a specific mission.

Cost Effectiveness Analysis. A method, for examining alternative means of accomplishing desired military missions for the purpose of selecting weapons and forces which will provide the greatest military effectiveness for the cost.

Deployment/Operational Phase. The Deployment/Operational (use) Phase in the life cycle is the period during which the operating forces use the weapon system/equipment. This phase begins with initial deliveries to the operating forces and extends until the item is retired from the operating inventory.

Effectiveness. The probability that the material will operate successfully when required.

Environmental Operating Conditions. Those factors of environment which singly, or in combination have a significant effect upon military operations, and must, therefore, be considered in the design and testing of systems and equipments.

Facilities. Real property, including all buildings and land and permanent improvements thereto, including access roads and railroad spurs, security fencing, utility lines, dedicated spaces, piers required for operation and support of a system or equipment.

Feasibility Study. A study to determine whether a plan is capable of being accomplished successfully.

Force Structure Costing. The determination of the resource implications (manpower, material, support, training) of a given force structure in dollar terms.

Full Scale Development Phase. The Full Scale Development Phase is the phase during which the weapon system, including all of the items necessary for its logistic and operational support (training equipment, support equipment, handbooks for operation and maintenance, etc.) is designed, fabricated and tested. The intended output is a hardware model, a defined logistic support system, and the documentation needed to produce for inventory use.

Functional Analysis. An approach to the solution of a problem, in which the problem is broken down into its component functions, such as intelligence, firepower, or mobility. Each relevant function is then further analyzed and broken down into smaller functional components until a level of molecularity suitable for solution of the problem is attained.

Integrated Logistic Support. Integrated logistic support is a composite of all the support considerations necessary to assure the effective and economical support of a system for its life cycle. It is an integral part of all other aspects of system acquisition and operation. Integrated logistic support is characterized by harmony and coherence

among all the logistic elements. The principal elements of integrated logistic support related to the overall system life cycle include:

1. The Maintenance Plan
2. Support and Test Equipment
3. Supply Support
4. Transportation and Handling
5. Technical Data
6. Facilities
7. Personnel and Training
8. Logistic Support Resource Funds
9. Logistic Support Management Information

<u>Intermediate Maintenance</u>. That maintenance which is the responsibility of and performed by designated maintenance activities for direct support of using organizations. Its phases normally consist of calibration, repair or replacement of damaged or unserviceable parts, components or assemblies; the emergency manufacture of non-available parts; and providing technical assistance to using organizations. It normally is accomplished in fixed or mobile shops, tenders, or shore based repair facilities.

<u>Linear Programming</u>. A technique for solving certain kinds of problems involving many variables where a best value or set of values is to be found. This technique is not to be confused with computer programming, although problems using the technique may be programmed on a computer. It is a mathematical method used to determine the best use of limited resources to achieve a desired result when the limitations on the resources are expressed by simultaneous linear relations (x=a+by). Linear programming is applicable to problems involving resource allocations and scheduling.

<u>Level of Repair Analysis</u>. A term assigned to a technique which establishes (1) whether an item should be repaired; (2) at what maintenance level, i.e., organizational, intermediate, or depot; or (3) if the item should be discarded.

Life Cycle Costing. Life Cycle Costing (LCC) is an acquisition or procurement technique which considers operating, maintenance, and other costs of ownership as well as acquisition price in the award of contracts for hardware and related support.

Logistics. The science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, those aspects of military operations which deal with: a. design and development, acquisition, storage, movement, distribution, maintenance, evacuation, and disposition of materials; b. movement, evacuation, and hospitalization of personnel; c. acquisition or construction, maintenance, operation, and disposition of facilities; and d. acquisition or furnishing of services.

Logistic Planning. Logistic planning is the determining of the logistic posture to be established for support of a weapon/support system program based upon prescribed mission objectives to be achieved.

Logistic Resources. The support personnel and material required by an item to ensure its mission performance. It includes such things as tools, test equipment, repair parts, facilities, technical manuals, and administrative supply procedures necessary to assure the availability of these resources when needed.

Logistic Support Analysis - A process by which the logistic support necessary for a new system/equipment is identified. It includes the determination and establishment of logistic support design constraints, consideration of those constraints in the design of the "hardware" portion of the system, and analysis of

design to validate the logistic support feasibility of the design, and to identify and document the logistic support resources which must be provided, as a part of the system/equipment, to the operating forces. Analytical techniques used to determine limited aspects of logistic support requirements are a part of the overall LSA process. (An example would be Operational Sequential Diagramming used to determine operator tasks, task times, and skills.)

Logistic Support Elements. Constitutent parts of a support system. The principal elements are the maintenance plan, support and test equipment, facilities, training, technical data, personnel, supply support, transportation and handling equipment, and logistic support resource funds.

Logistic Support Resource Funds. The money required for the identification, acquisition, and management of logistic resources.

Logistic Support Management Information. Information used for the analysis and reporting of actions taken or required to be taken in developing or executing logistic support plans.

Maintenance Concept. A description of the maintenance tasks required in support of a given system or equipment and the designation of the maintenance level for performing each task. The maintenance concept will be incorporated into the maintenance plan.

Maintenance Plan. A description of the requirements and tasks to be accomplished for achieving, restoring, or maintaining

the operational capability of a system, equipment, or facility. The maintenance plan is normally one of the parts of the Integrated Logistic Support Plan.

Maintenance Engineering. The application of techniques, engineering skills and effort, organized to insure that the design and development of weapon systems and equipment provide adequately for their effective and economical maintenance.

Major Weapons System. One of a limited number of systems or subsystems which, for reasons of military urgency, criticality, or resource requirements, is determined by DOD as being vital to the national interest.

Mean-Maintenance-Time. The total preventive and corrective maintenance time divided by the total number of preventive and corrective maintenance actions during a specified period of time.

Mean-Time-Between-Failures. The mean operating time between failures during which time the item performs as specified.

Mean Time Between Maintenance. Total usage this time period is divided by the sum of all maintenance actions on the item.

Military Operational Requirements. The formal expression of a military need, response to which results in development or acquisition of items, equipments, or system.

Monte Carlo Method. Any procedure that involves statistical sampling techniques from a distribution of possible outcomes in obtaining a probablistic approximation to the solution of a mathematical or physical problem. A simulation uses this method

when there are sequences of statistical events that prevent one from obtaining precise mathematical answers. In such cases individual runs are often replicated to determine the range of possible outcomes.

Operational Phase. The period in the system life cycle which starts with the delivery of the first inventory unit or installation to the unit command and terminates with disposition of the system from the inventory.

Operational Readiness. The capability of a unit, ship, weapon system, or equipment to perform the missions or functions for which it is organized or designed. May be used in a general sense or to express a level or degree of readiness.

Operational Test and Evaluation. The term denotes any program or project designed to obtain, verify, and provide data for conclusions about the suitability of operational systems, sub-systems, equipment, concepts, tactics, techniques, and procedures. The term test denotes the conduct of physical activity in pursuit of prescribed data objectives. The term evaluation denotes a review and analysis of quantitative or qualitative data produced by current test projects or programs, by previous testing, or by data provided from other sources, i.e., operational, research and development, supporting activities or from combinations of any of the foregoing.

Operationally Ready. Available and in condition for serving the functions for which designed.

Parametric Analysis. A parametric analysis assumes a range of values for each parameter which will bracket the expected values of that parameter, and a solution to the problem is obtained for each set of assumed parameter values.

Personnel. Personnel in the numbers and with the necessary skills required to operate and support a system or equipment in its operational environment.

Production Phase. The Production Phase begins at the end of the full scale development phase with the establishment of the product baseline (or in the case of ships, after the validation phase). Although some production may commence beroze, and some minor development may continue after, the establishment of the product baseline will make the beginning of the production phase.

Program Manager. An individual charged with the responsibility for design development and acquisition of the system/ equipment and for the design, development, and acquisition of the integrated logistic support.

Request for Proposal. The solicited contract between the Government and the contractor on a contemplated procurement. It is the medium by which a contractor is introduced to the job desired by conveying a complete understanding of the work to be performed and to determine the capability and price of the contractor's efforts. RFPs contain language, terms, and conditions necessary to obtain information from prospective bidders.

Supply Support. All functions and management actions necessary for determining requirements for acquisition, cataloging, packaging, preservation, receipt, storage, transfer, issue, and disposal of spares, repair parts, bulk materials, consumables, clothing, food, and fuel.

Support and Test Equipment. All equipment, mobile or fixed, required to support the operation and maintenance of a population of systems/equipments or facilities at all levels and all locations at which a requirement is planned.

Support Engineering. As used herein applies to the application of engineering and technical skills for the purpose of defining and developing the Support System.

Support Engineering Analysis. A body of analytical processes and techniques used to assess the result of a given design approach on the logistic support system; the impact of logistic support practices on a spècific design approach; and to determine the resources needed to support the end item.

Stochastic Process. The statistical concept underlying the prediction of the condition of an element of a larger group when the probable average condition of the larger group is known. For example, assume that an armored division, under certain circumstances, has on the average a certain number of tanks deadlined for unscheduled maintenance. The probability that any given tank under the same circumstances, will be deadlined for unscheduled maintenance on a specific day is described by a stochastic process.

Systems Engineering. The application of scientific and engineering efforts to (a) transform an operational need into a description of system performance parameters and a system configuration through the use of an iterative process of definition, synthesis, analysis, design, test, and evaluation; (b) integrate related technical parameters and assure compatibility of all physical, functional, and program interfaces in a manner which optimized the total system definition and design; (c) integrate reliability, maintainability, safety, human and other such factors into the total engineering effort.

Technical Data. Encompasses all types of specifications, standards, engineering drawings, instructions, reports, manuals, tabular data, and test results used in the development, production, testing, use, maintenance, and disposal of military items, equipments and systems.

Training. The processes, procedures and equipment used to train personnel in the operation and support of a system or equipment.

Transportation and Handling. The procedures, equipment, and facilities used for the packaging, movement, transfer, and handling of systems/equipments.

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